EMC CCB Meeting

HiresWindow v6.1

Presented by:

Matthew Pyle

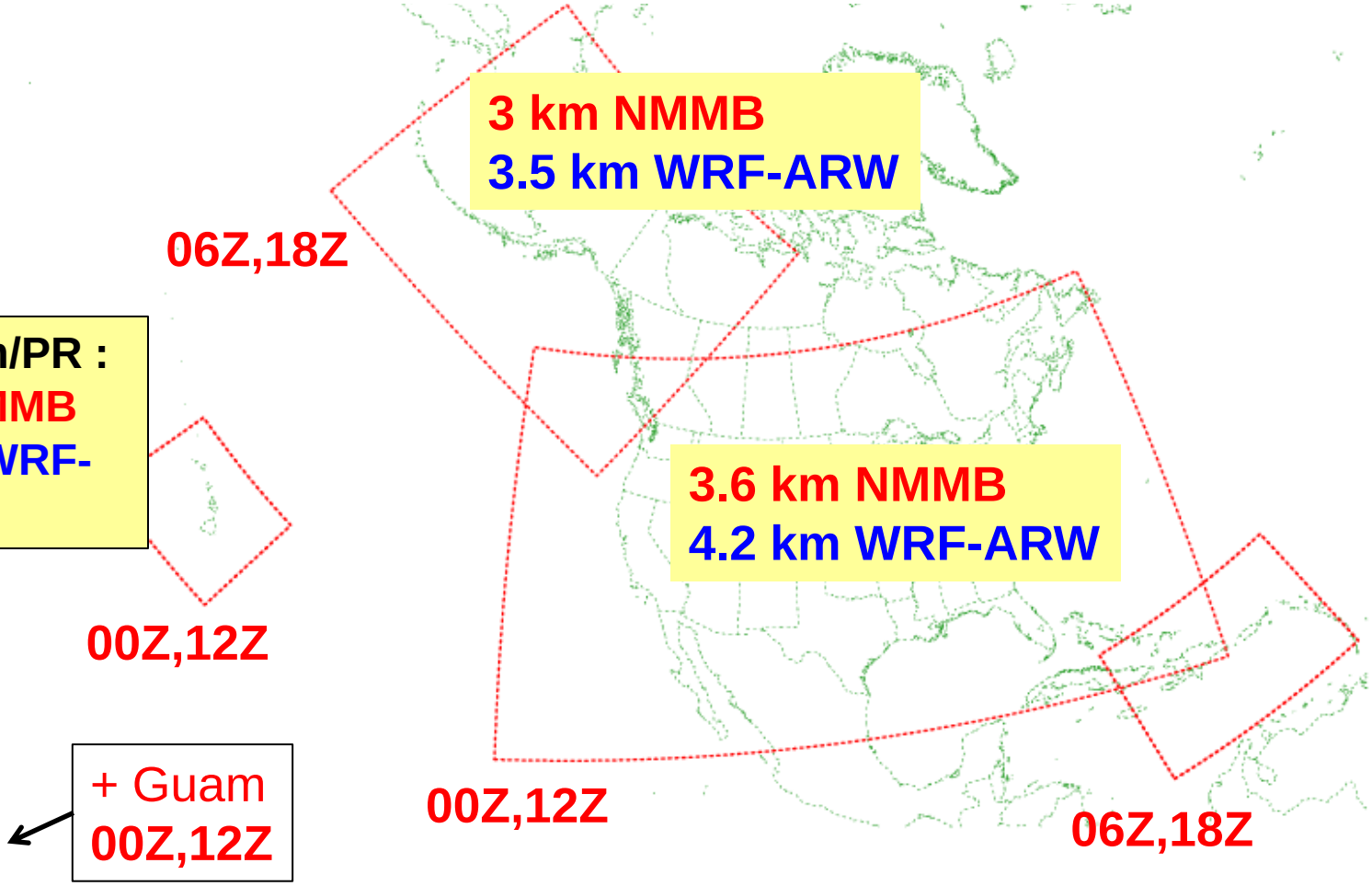
HiresW overview

- 3-4 km, no parameterized convection forecasts
- Two cores: WRF-ARW and NMMB
- Twice daily runs to 48 h over CONUS and four non-CONUS domains.

- Complements the NAM nests, helping to provide a variety (multi-model, multi-analysis) of high-resolution model solutions in the NCEP suite, forming a pseudo-ensemble.

HiresW overview

Integration domains and run times (unchanged)



Outline

- Upgrade elements – what is changing and why
- Pre-implementation testing to date
- Parallel testing evaluation – stats and examples
  - Echo top height and reflectivity
  - Precipitation
  - Surface sensible weather
  - PBL and surface layer
  - Synoptic/upper air

Upgrade elements

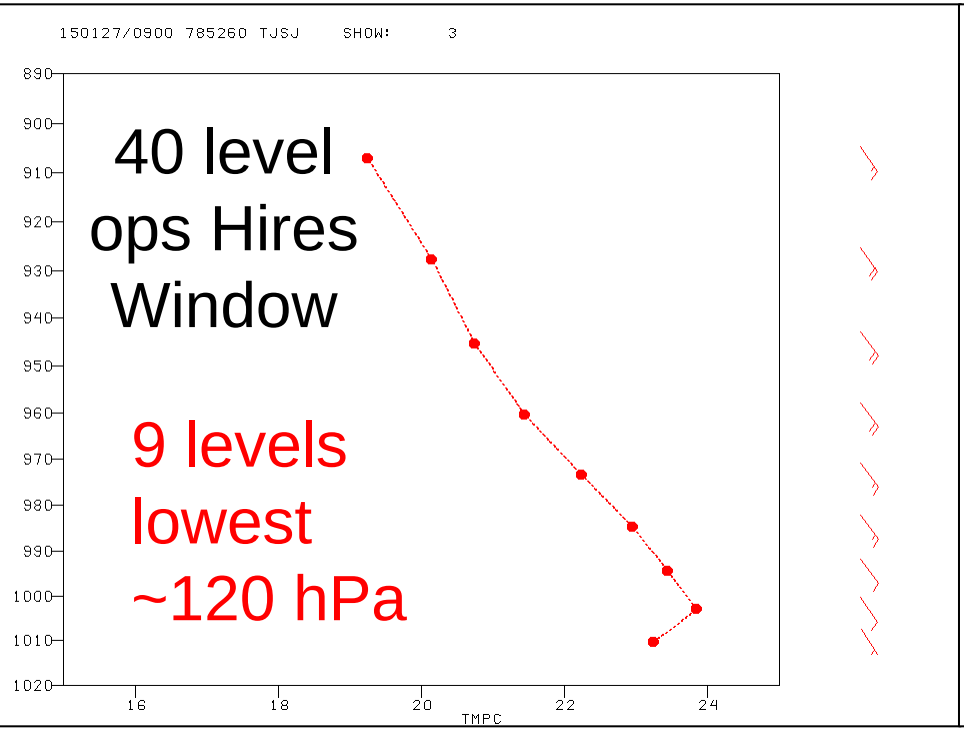
- Many infrastructure changes, the largest being the direct production of GRIB2 output. Also adds job restartability.
- Model code updates*
- Increase in vertical resolution (40 to 50 levels)*
- New/revised products:
  - High Resolution Ensemble Forecast (HREF) – ensemble guidance produced from time-lagged HiresW and NAM nest output
  - New products for aviation and severe weather*

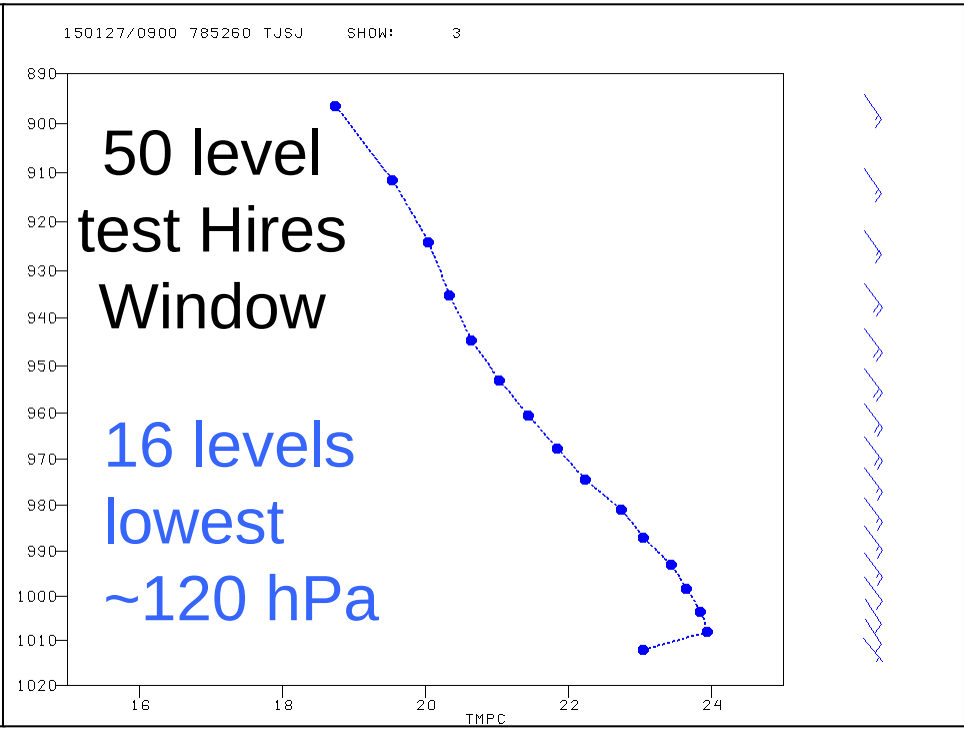
Upgrade elements

	Current prod	Planned upgrade
Model code version	WRFV3.5 (ARW) Aug 2013 trunk (NMMB) + updates	WRFV3.6.1 (ARW) + updates Jan 2015 trunk (NMMB) + updates
Vertical levels	40	50
Microphysics (ARW)	WSM6	Modified WSM6 (to slow graupel production, benefiting echo top height forecasts)

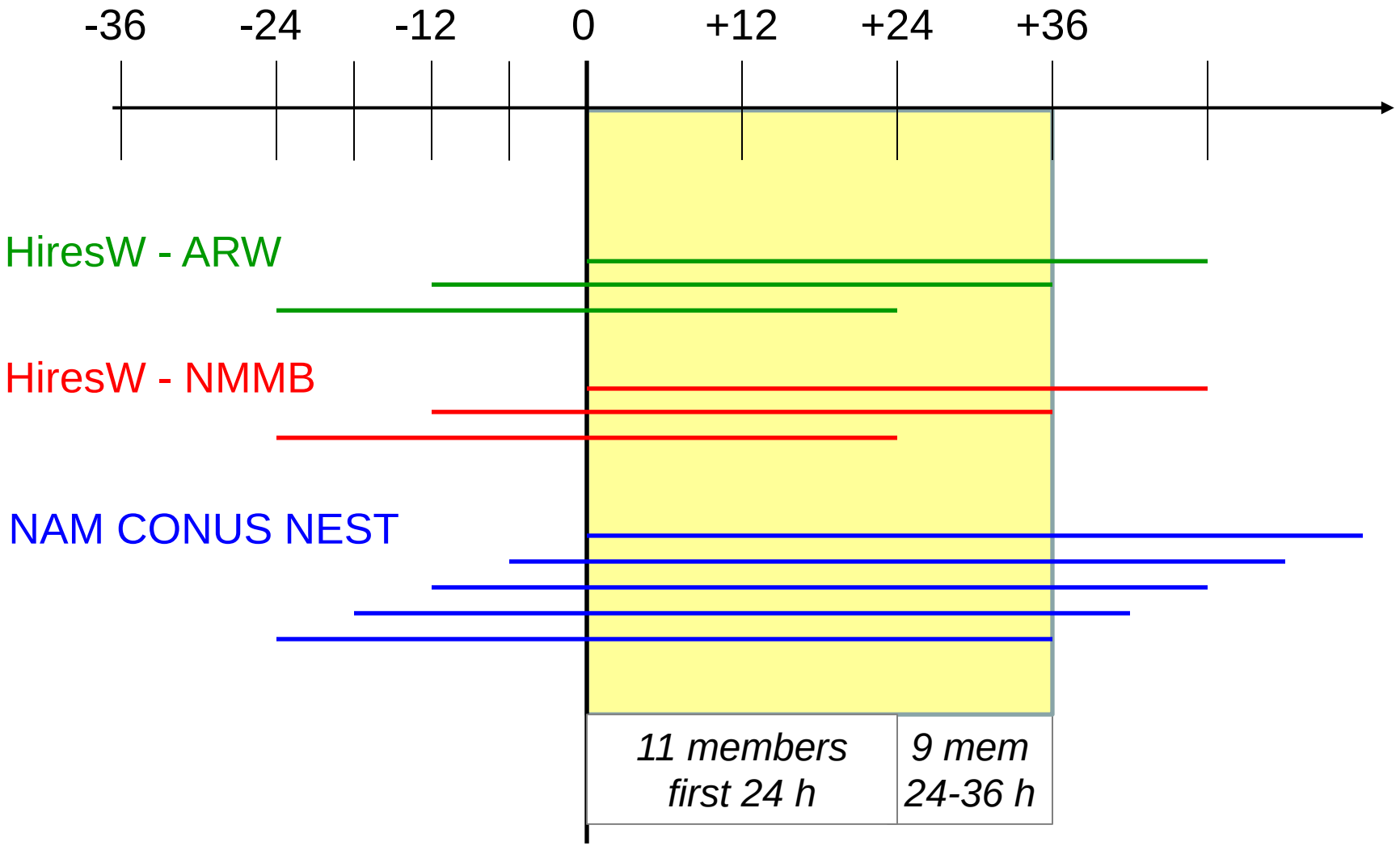
Extends certain Grasso et al (2014) suggestions – Brad Ferrier provided key guidance

Enhanced vertical resolution, particularly in PBL



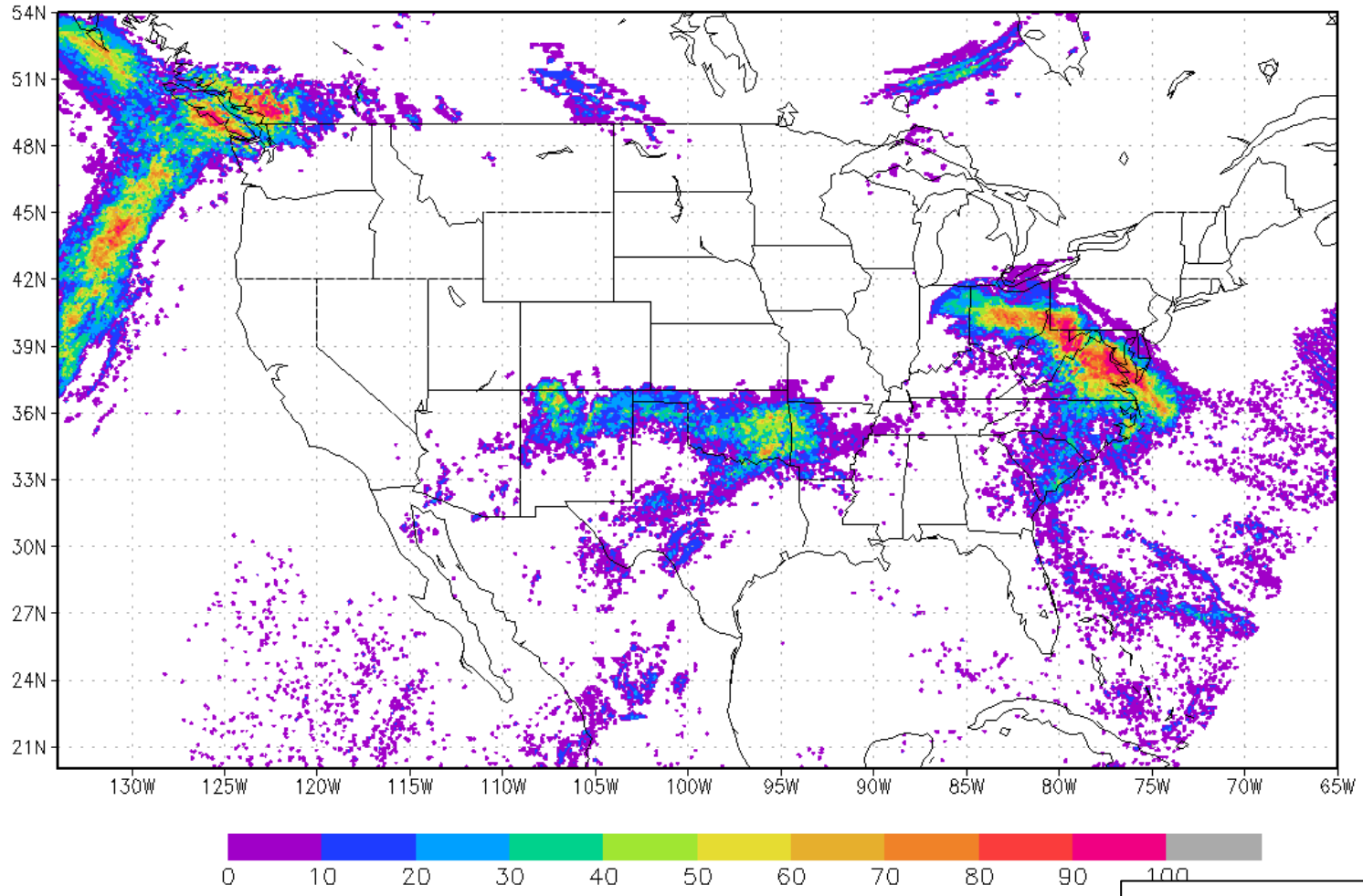


HREF membership overview



HREF example

probability of exceedance, REFC > 30 dBZ



courtesy Binbin Zhou

Upgrade elements

Expected benefits to end users from upgrade:

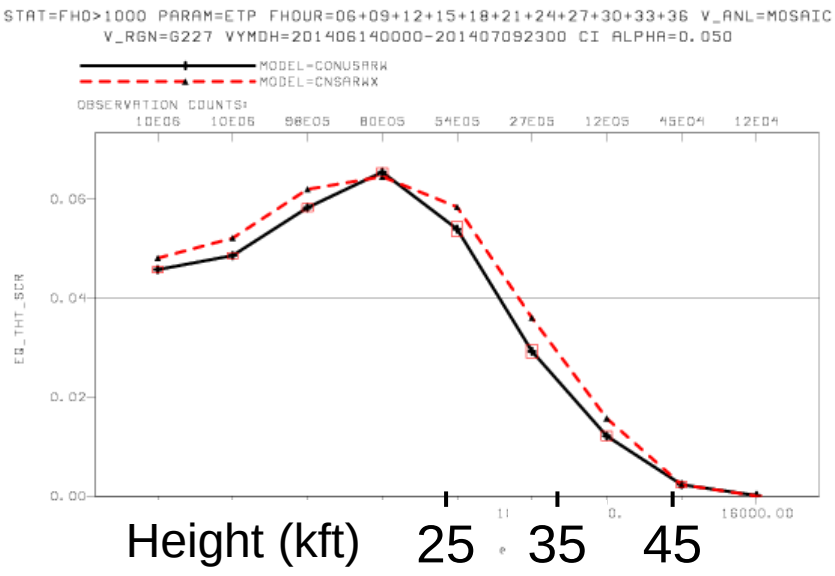
- Improved echo top height bias from WRF-ARW (only model improvement targeted in scope of upgrade)
- Improved precipitation bias performance
- Better resolution of PBL and surface layer features
- New forecasting tools:
  - Probabilistic HREF guidance
  - Ceiling height (AWC), -10 C reflectivity (lightning proxy)

Pre-Implementation Testing

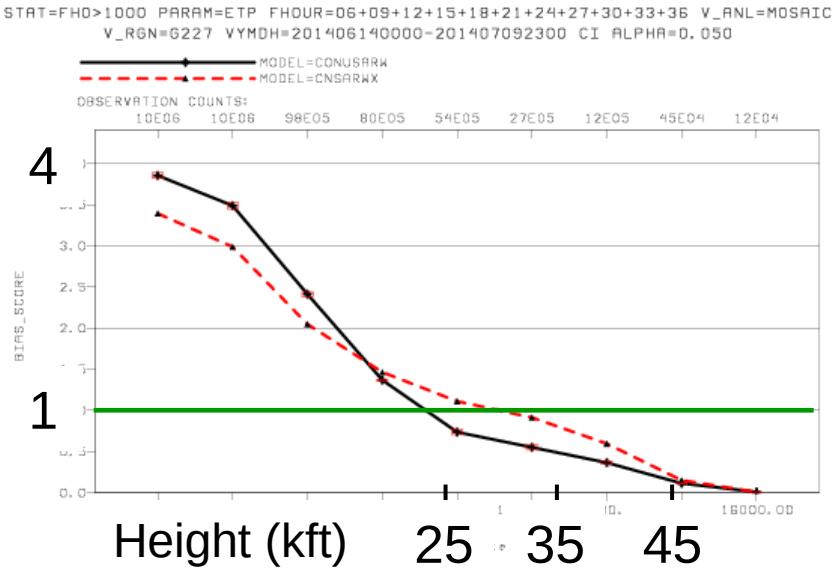
- Retrospective testing (thus far):
  - Warm season (June 13 - Jul 8, 2014)
  - Cool season (Jan 26 – Feb 26, 2015)
  - Large domains (CONUS/AK) + PR completed – HI & Guam in progress
- Retrospective testing limited somewhat due to the lack of a full spring convective season for current ops HiresW 6.0.x (implemented June 2014).
- See improvement in targeted fields (especially echo top height in WRF-ARW), but many/most results neutral.

Warm season echo top for WRF-ARW

Equitable threat score



Bias



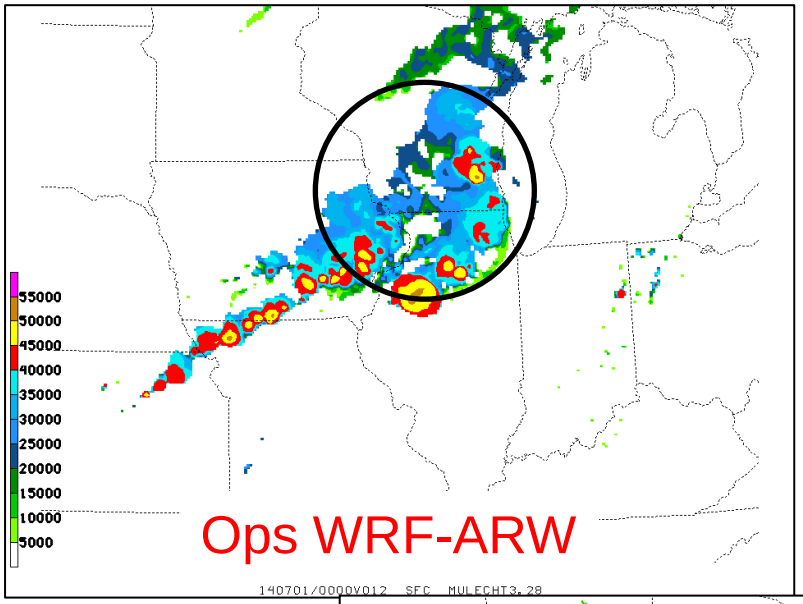
Grid-to-grid verification against radar mosaic

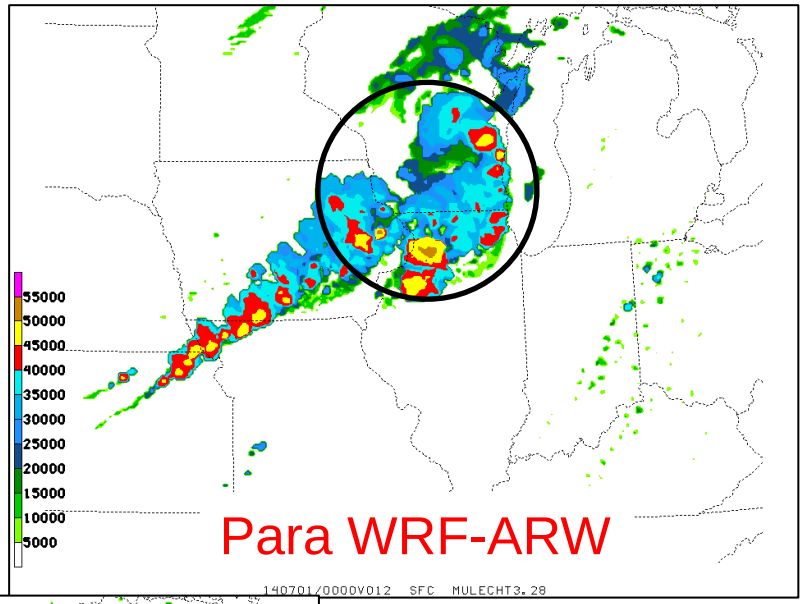
Ops HiresW

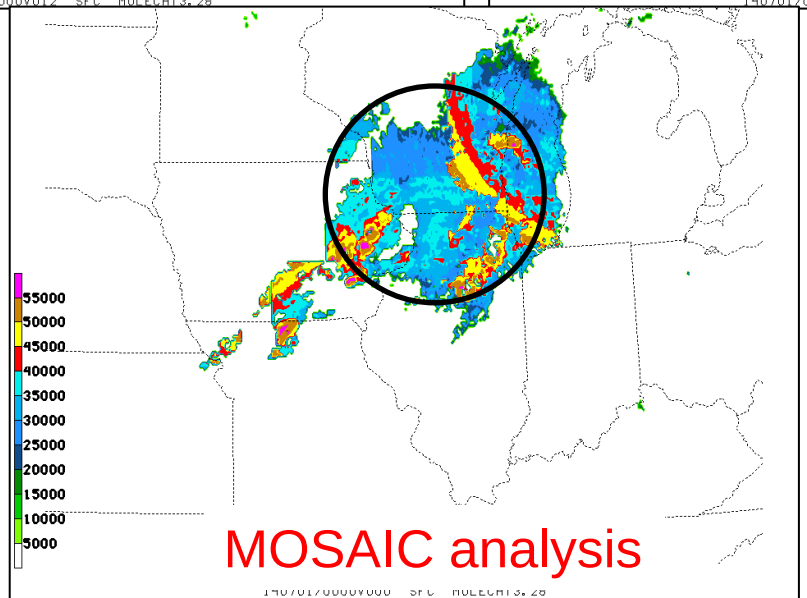
Para HiresW

Improvements both to ETS and bias; low bias reduced in 25-45K foot range important for aviation.

Echo top example
1 Jul 2014, 00Z



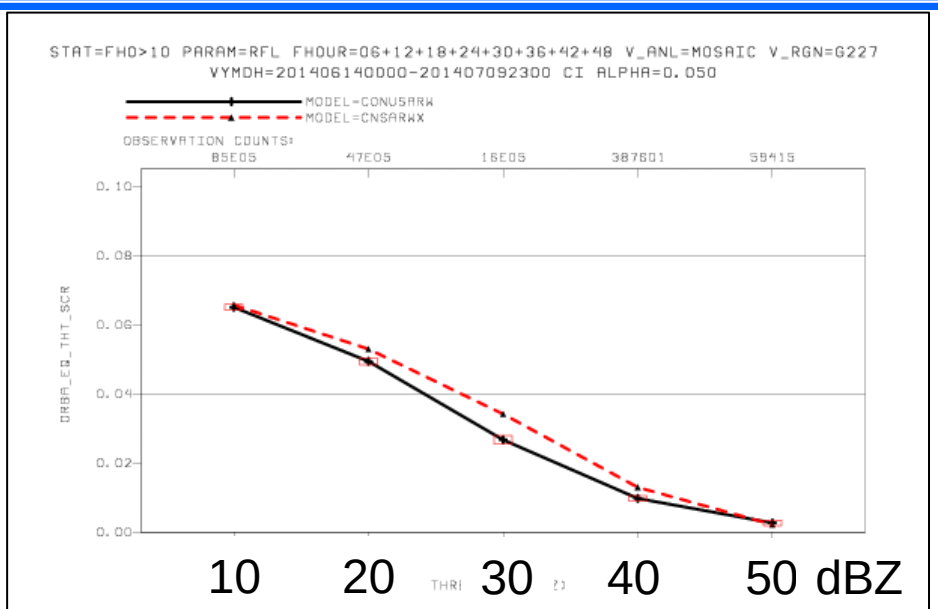




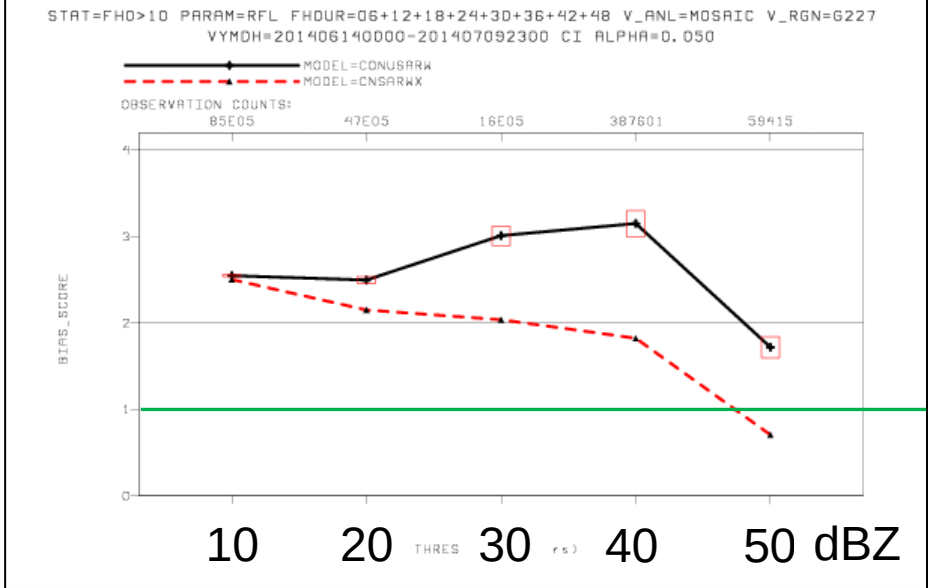
The para WRF-ARW has broader coverage in 25-40K foot range (pale blue colors)

Warm season composite reflectivity for WRF-ARW

Bias corr Equitable Threat Score



Bias



Grid-to-grid verification against radar mosaic

Ops HiresW

Para HiresW

Large bias difference from:

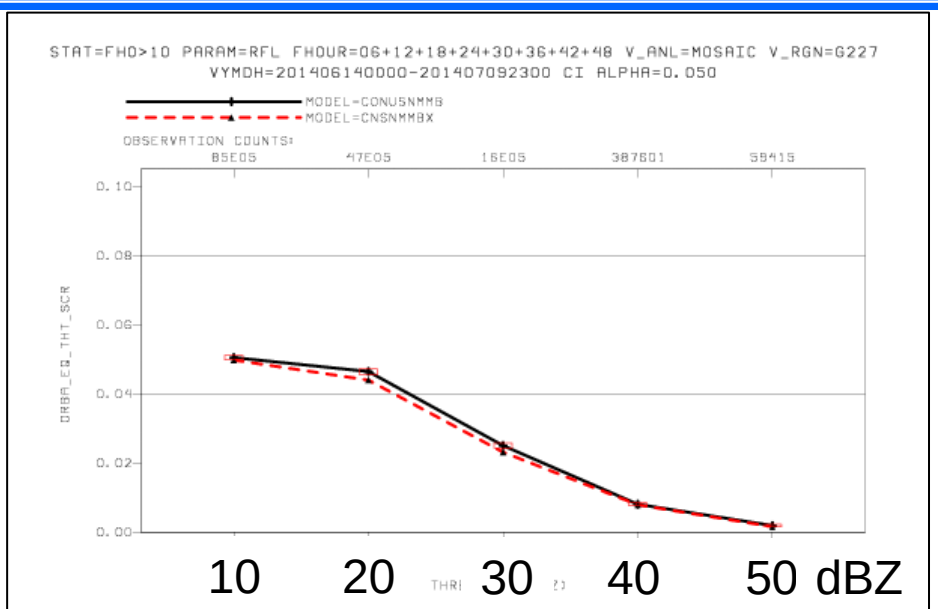
- WSM6 changes
- *shift from model-generated to post-generated reflectivity*

bias=1

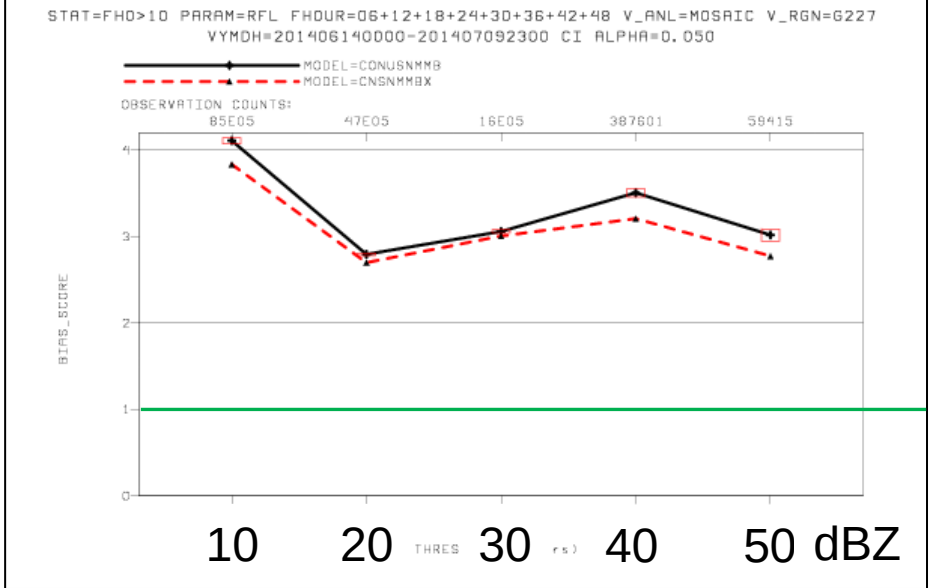
Warm season composite reflectivity for NMMB

Grid-to-grid verification against radar mosaic

Bias corr Equitable Threat Score



Bias



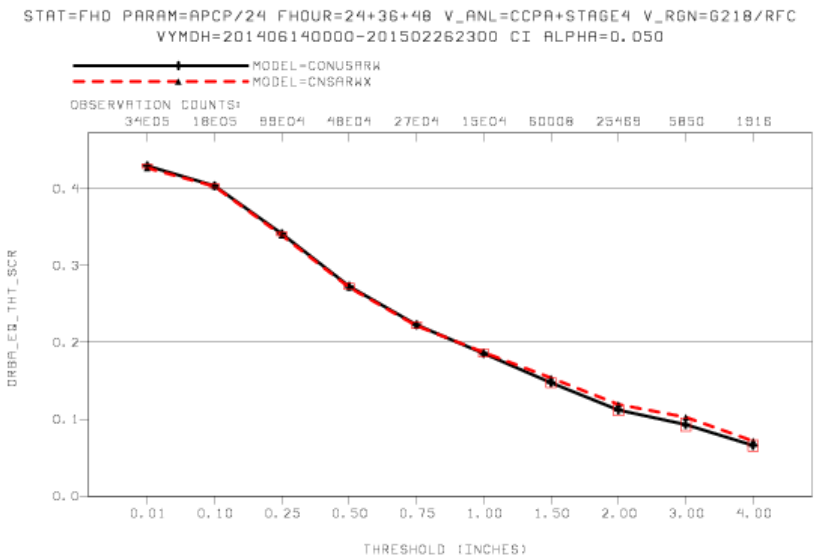
Ops HiresW

Para HiresW

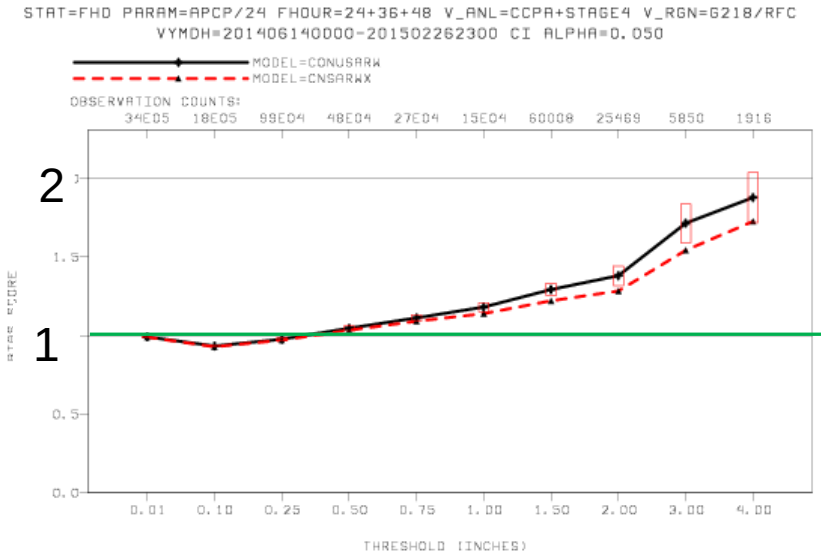
bias=1

CONUS ARW precipitation – all test cases

Bias corr Equitable Threat Score



Bias



June 13 – July 8, 2014
Jan 25 – Feb 26, 2015

24/36/48 h precip verification over CONUS

Ops HiresW

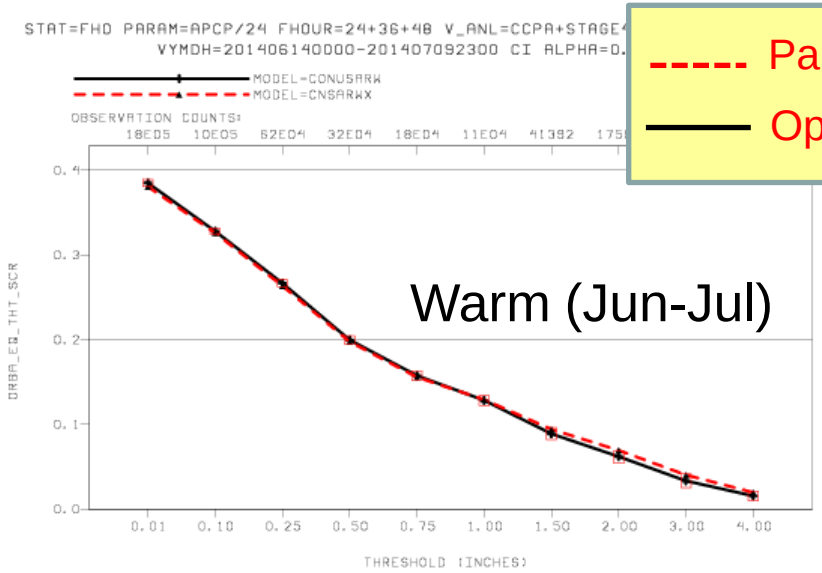
Para HiresW

bias=1

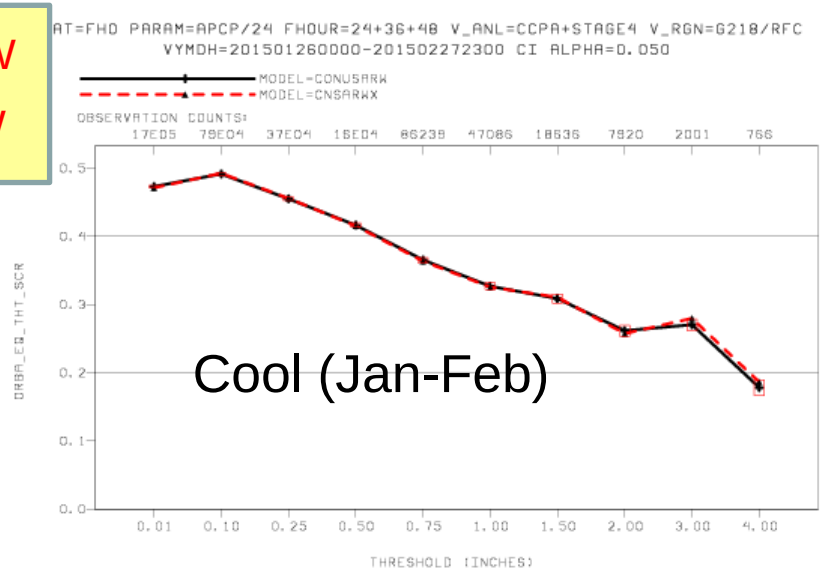
CONUS ARW precipitation – by season

Para HiresW

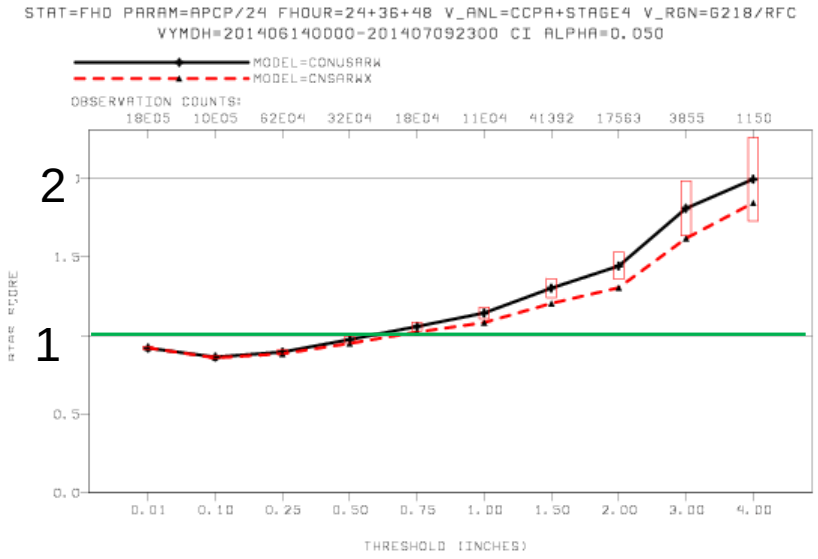
Ops HiresW



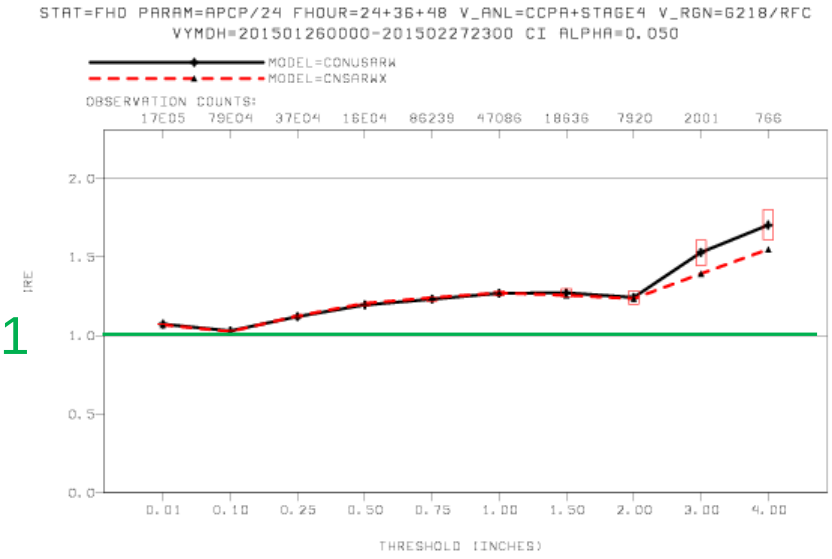
Warm (Jun-Jul)



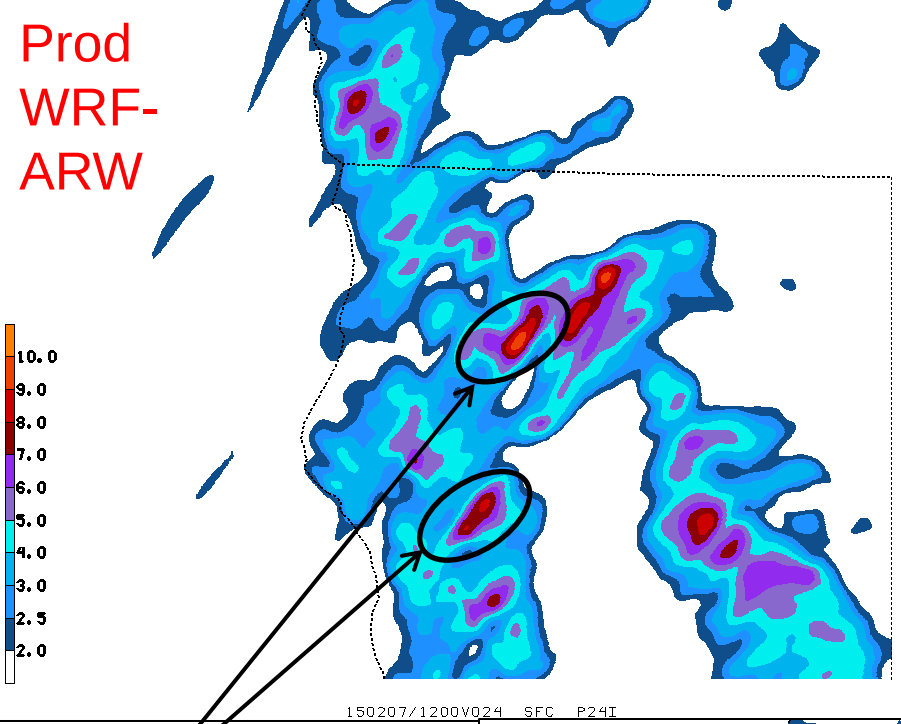
Cool (Jan-Feb)



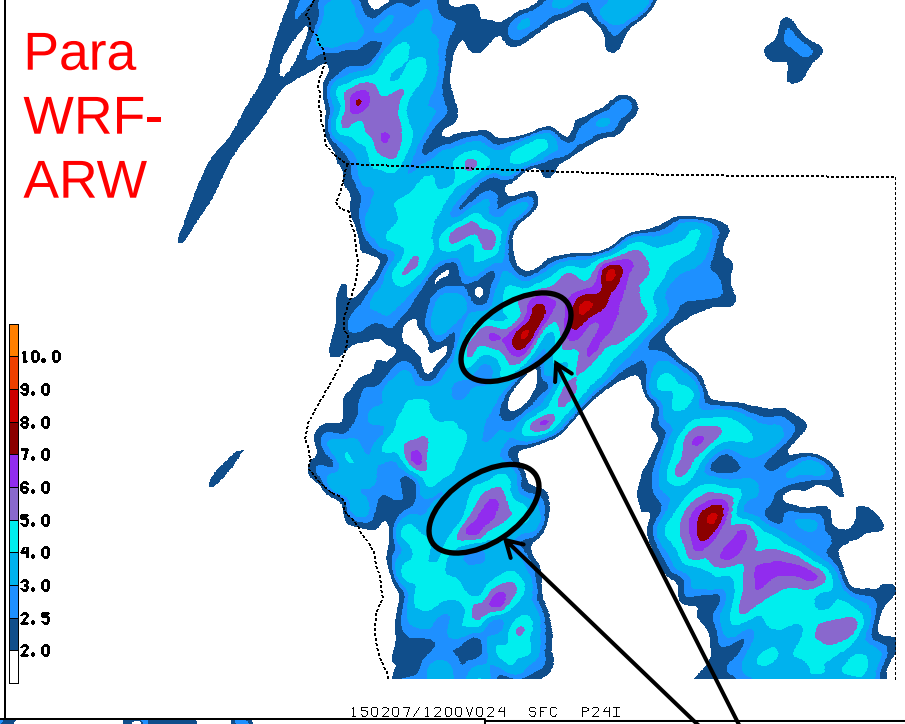
bias=1



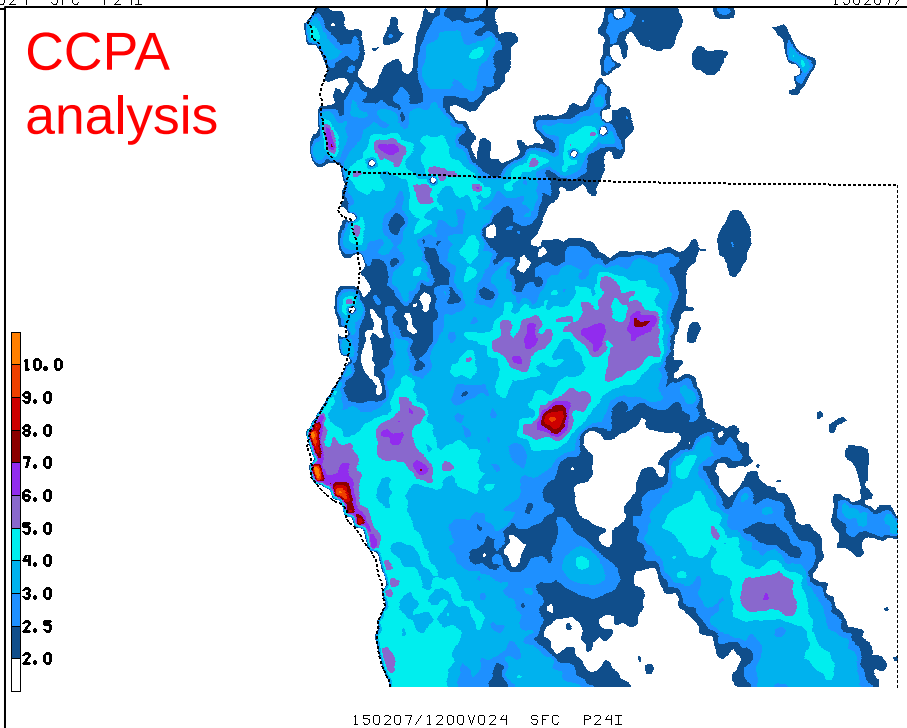
Prod WRF-ARW



Para WRF-ARW



CCPA analysis



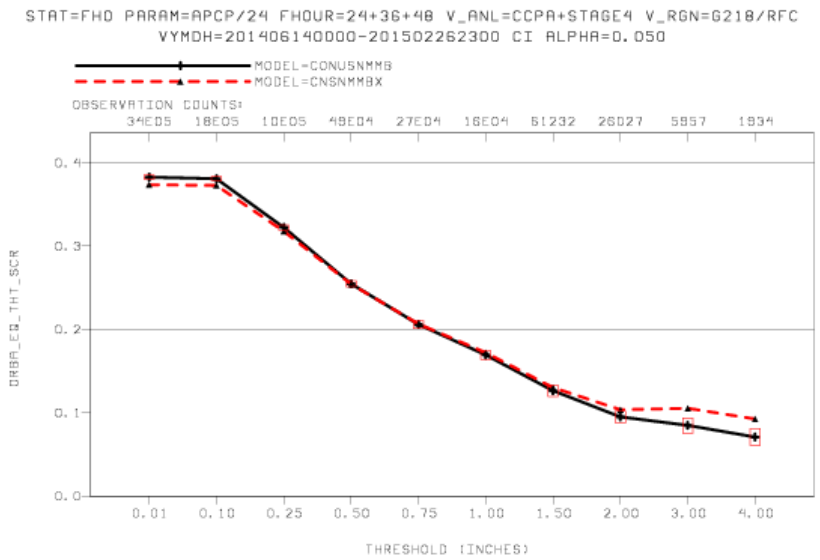
Overdone heavy precipitation (relative to CCPA analysis) in prod run…

…slightly better in para run (reduced coverage of 8”+ maxima)

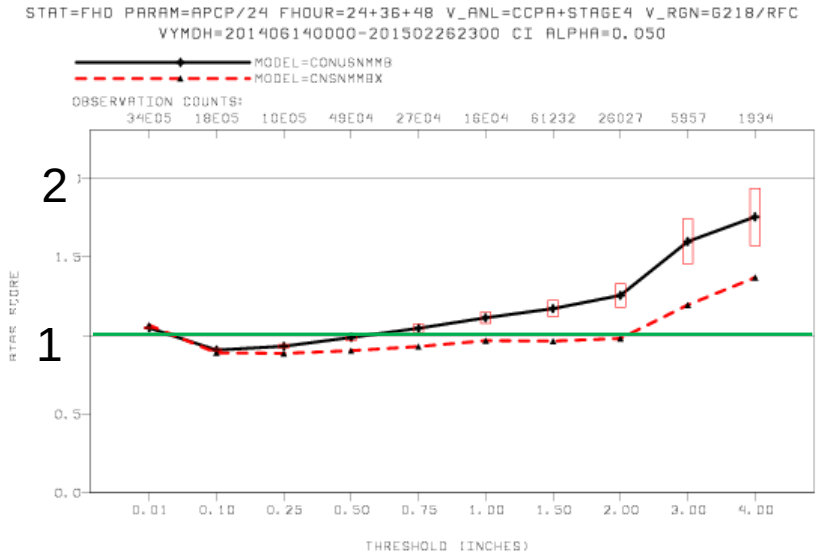
NOTE: Only precip >2” plotted

CONUS NMMB precipitation – all test cases

Bias corr Equitable Threat Score



Bias



June 13 – July 8, 2014
Jan 25 – Feb 26, 2015

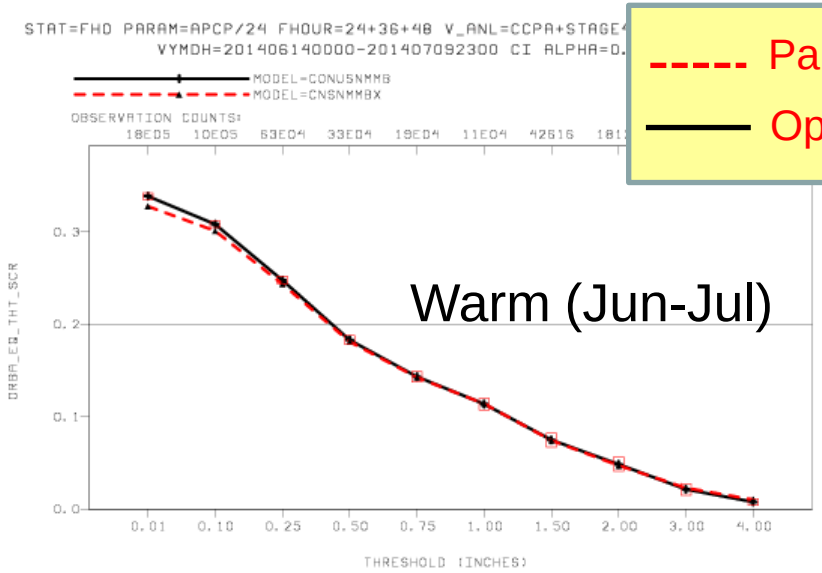
24/36/48 h precip verification over CONUS

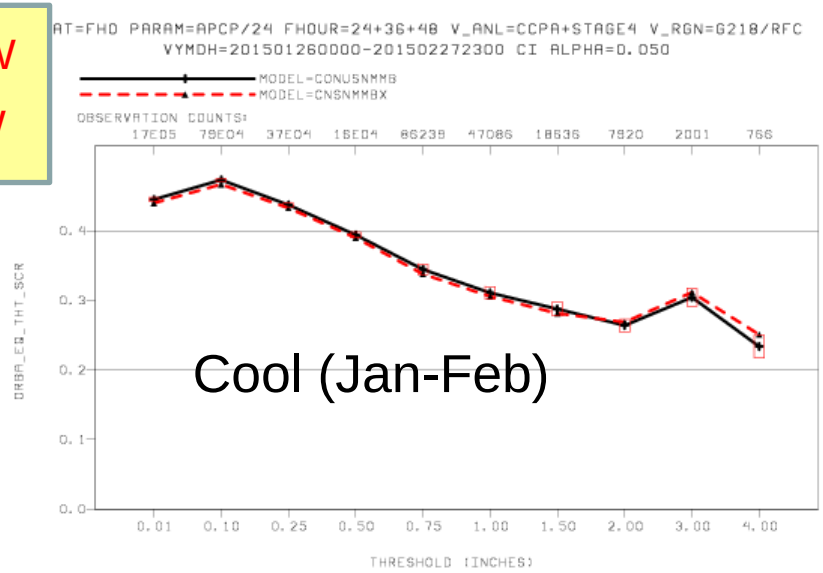
Ops HiresW

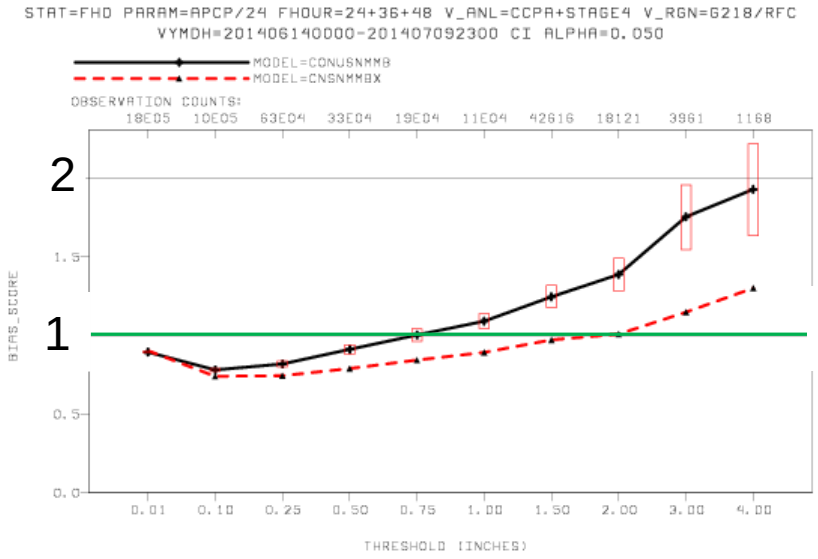
Para HiresW

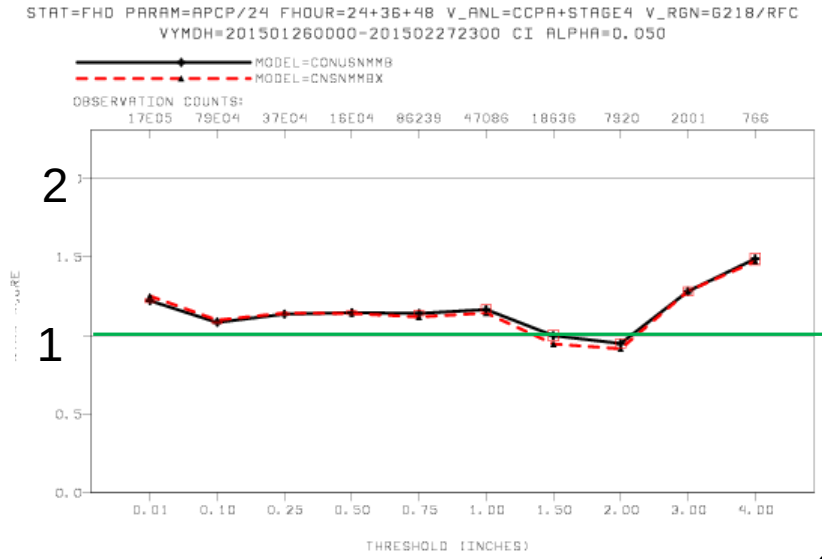
bias=1

CONUS NMMB precipitation – by season



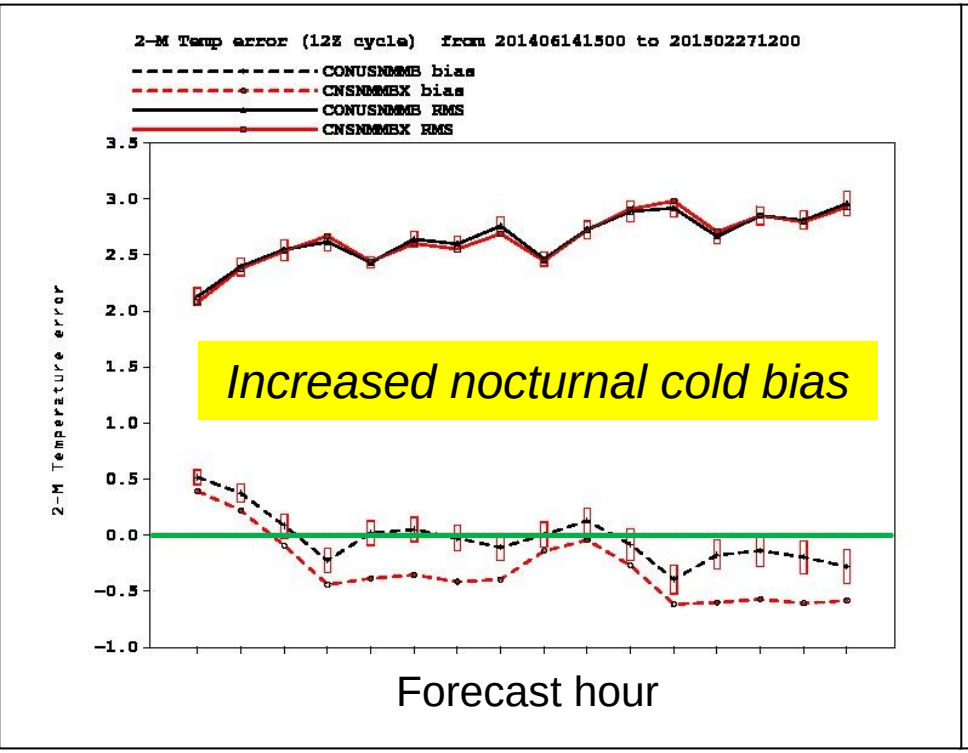




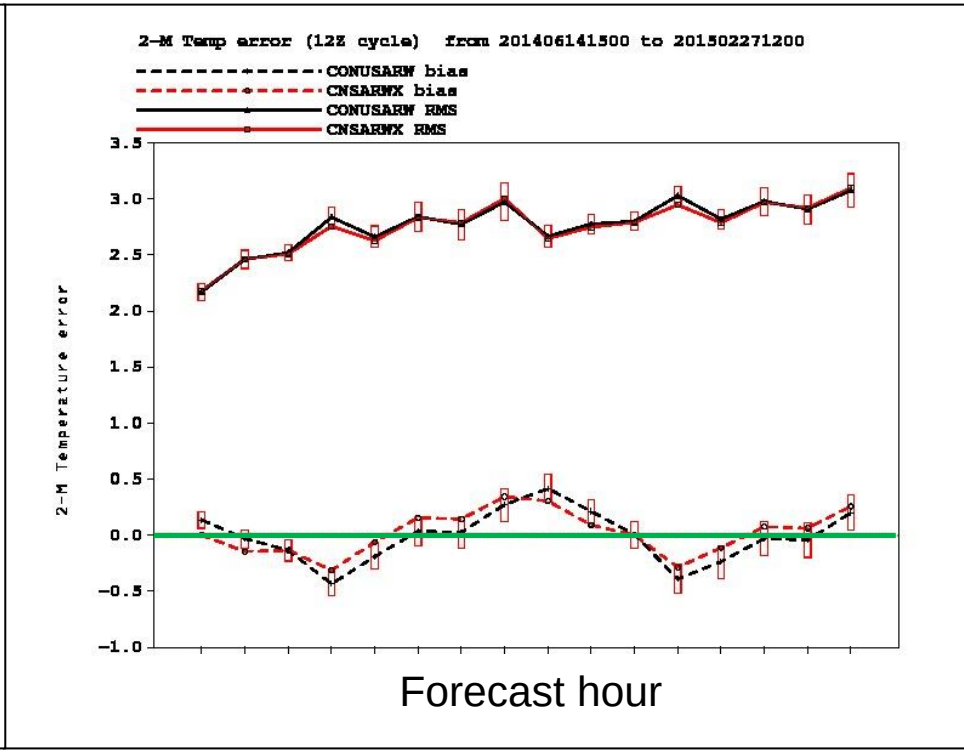


CONUS 2 m temp, 12Z cycle

ops RMS
para RMS
ops bias
para bias



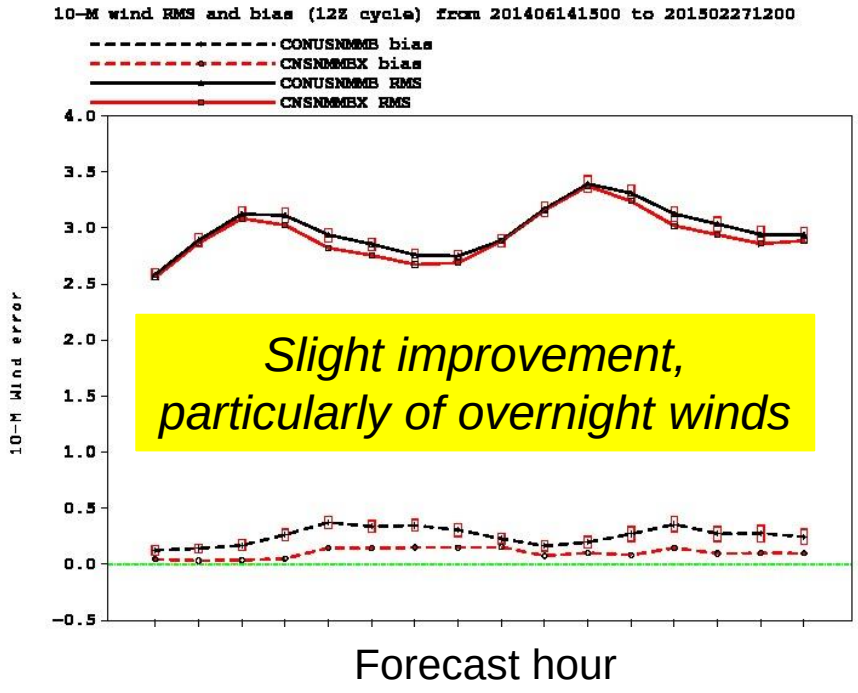
NMMB



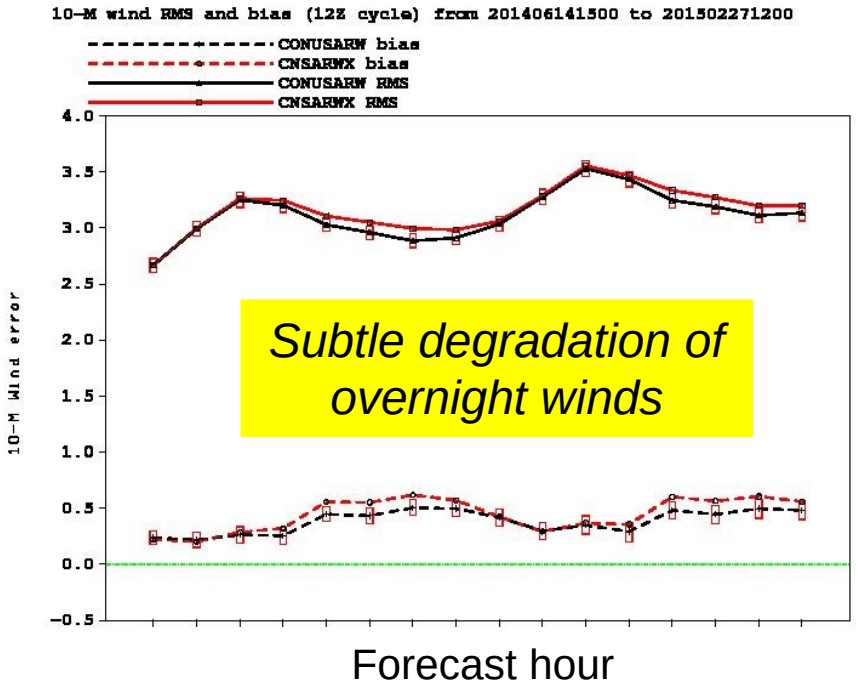
WRF-ARW

CONUS 10 m winds, 12Z cycle

ops RMS
para RMS
ops bias
para bias



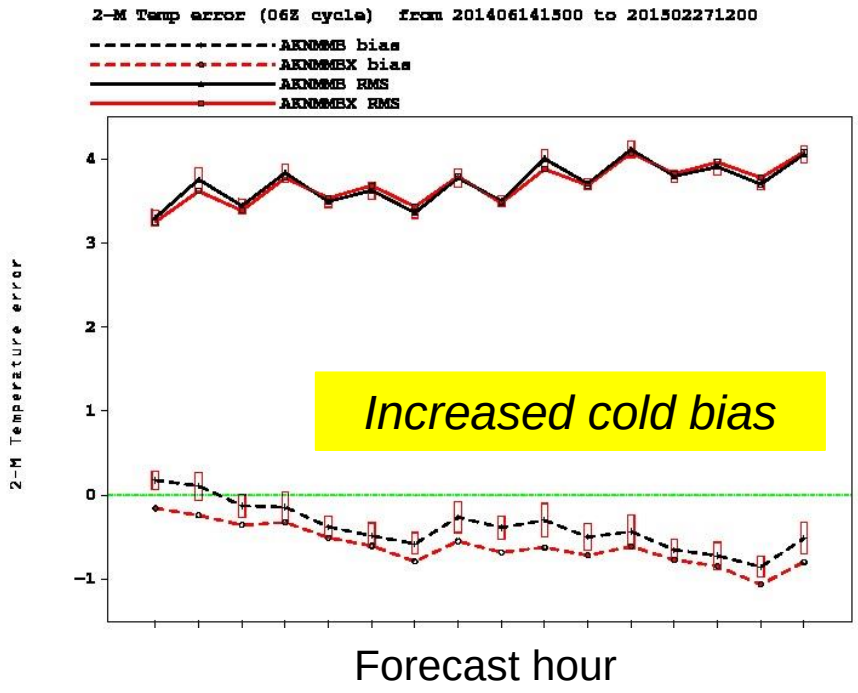
NMMB



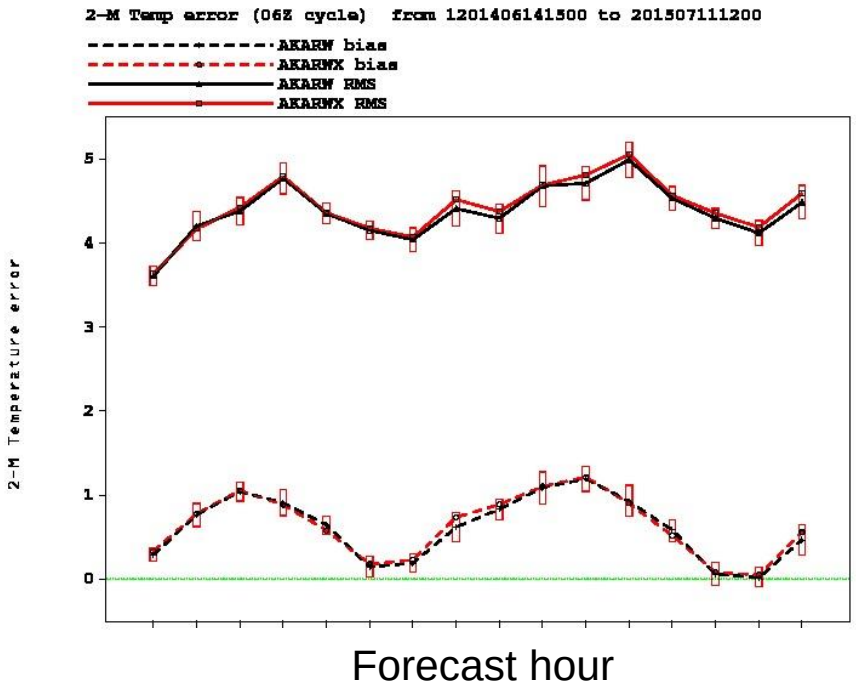
WRF-ARW

AK 2 m temp, 06Z cycle

ops RMS
para RMS
ops bias
para bias



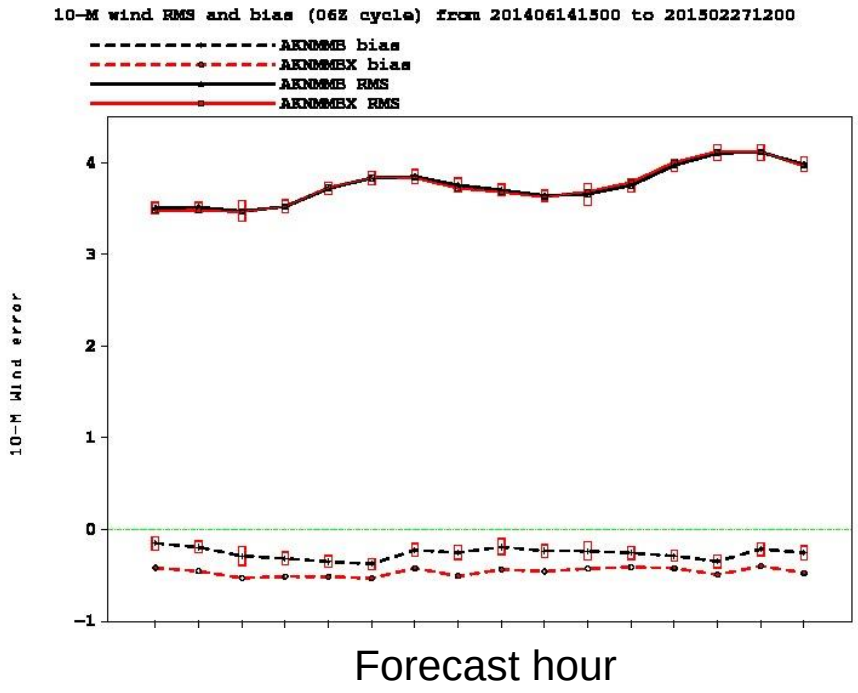
NMMB



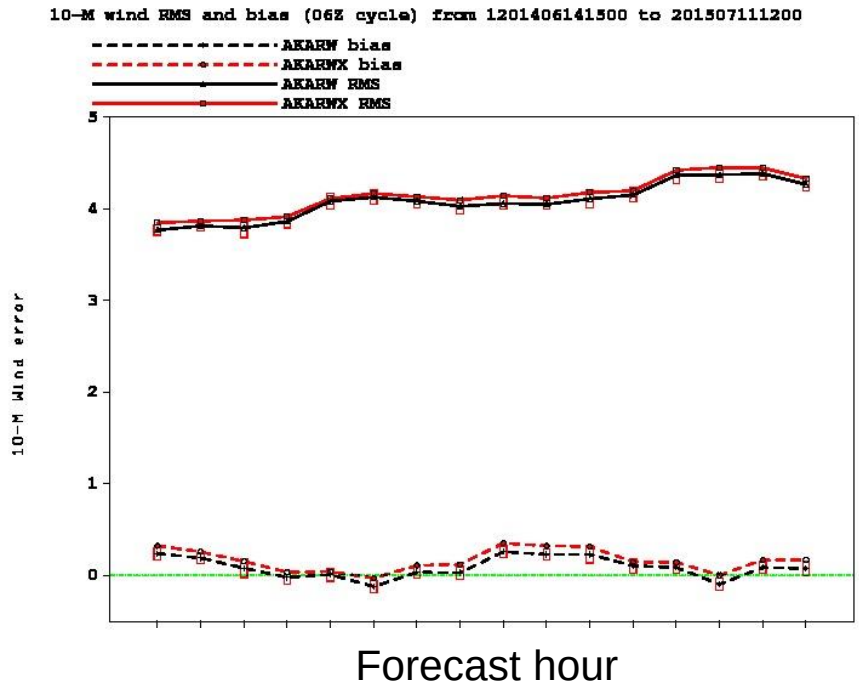
WRF-ARW

AK 10 m winds, 06Z cycle

ops RMS
para RMS
ops bias
para bias



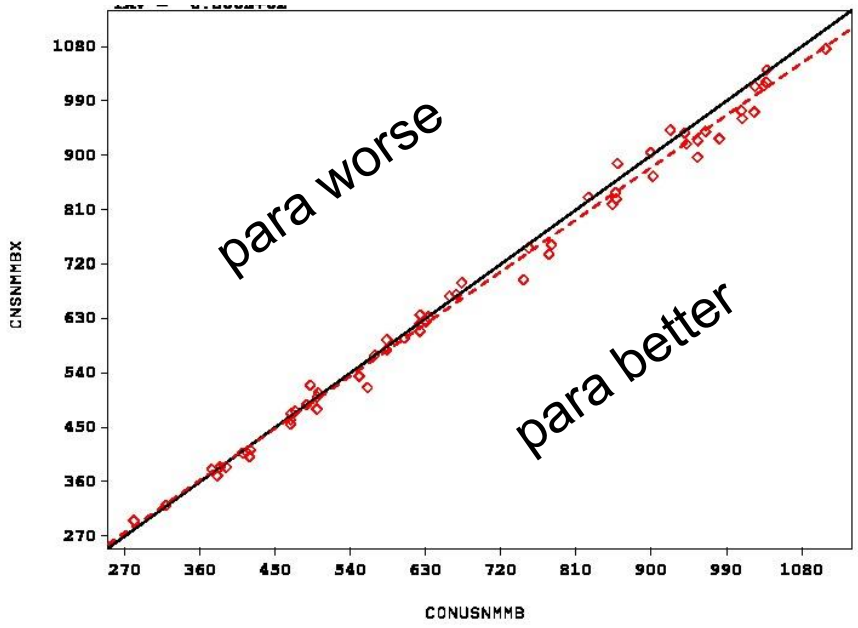
NMMB



WRF-ARW

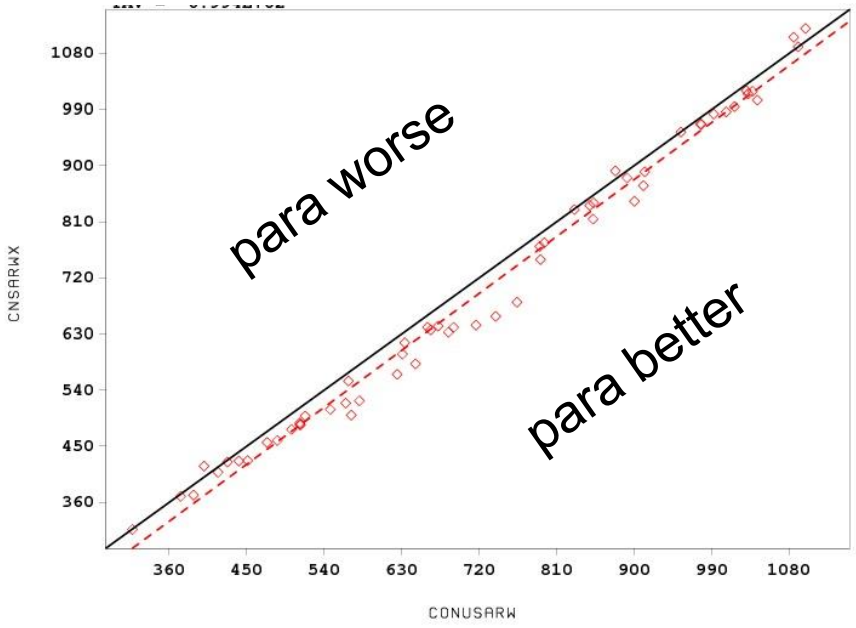
Improved convective PBL height forecasts (warm & cold season, valid 00Z)

CONUS NMMB



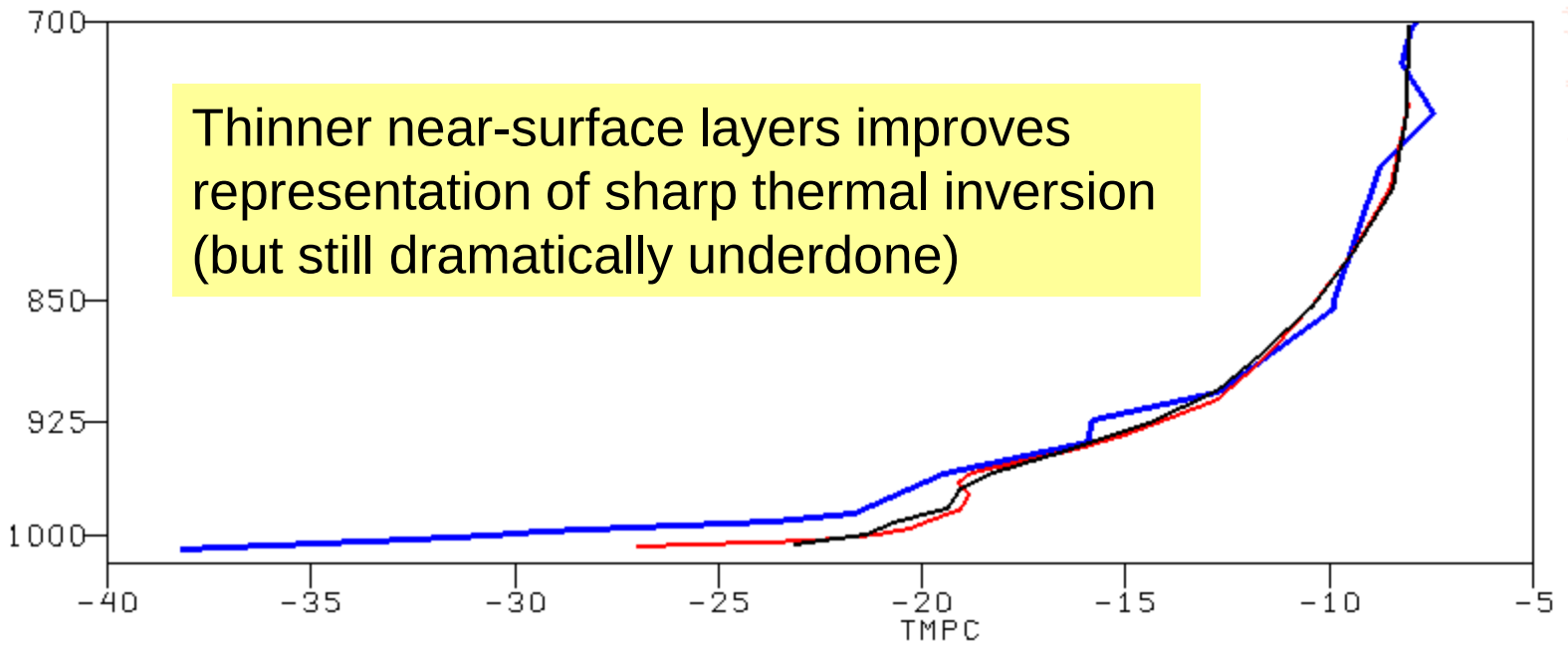
11 m reduction in RMS error

CONUS WRF-ARW



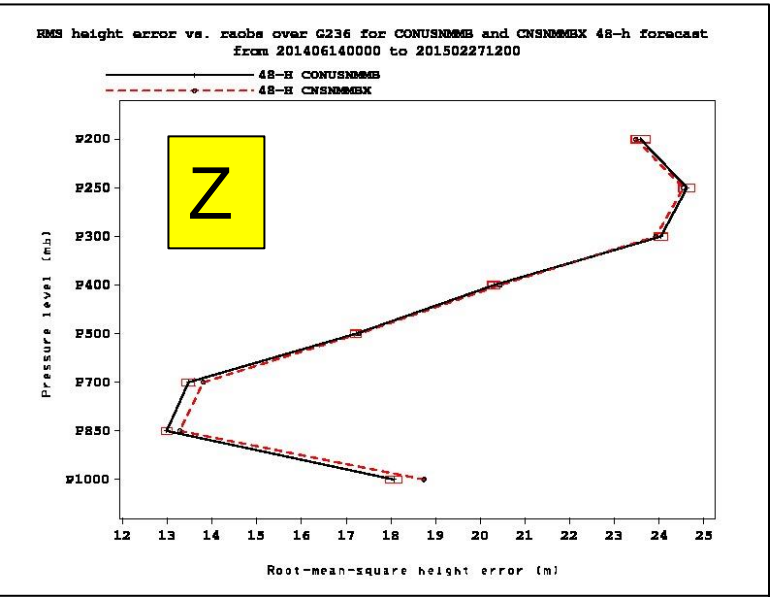
25 m reduction in RMS error

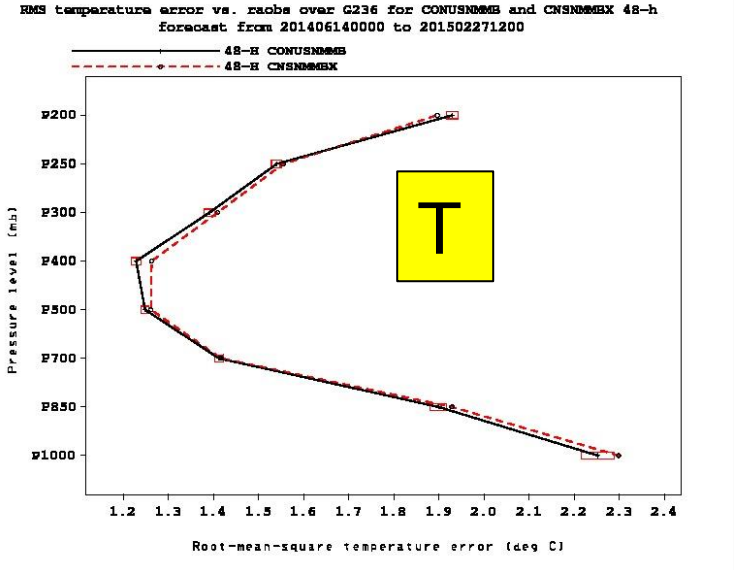
Improved representation of shallow arctic air



Alaskan NMMB run

RMS errors at 48 h forecast time for CONUS – NMMB

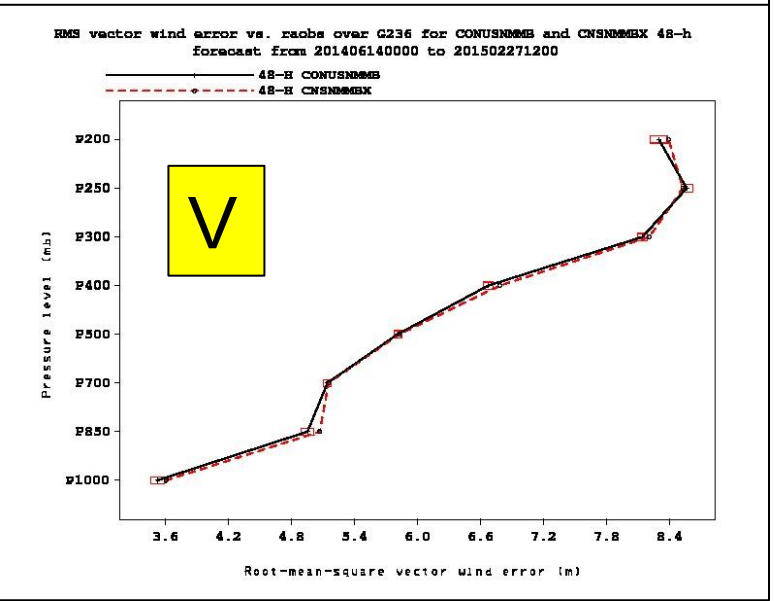


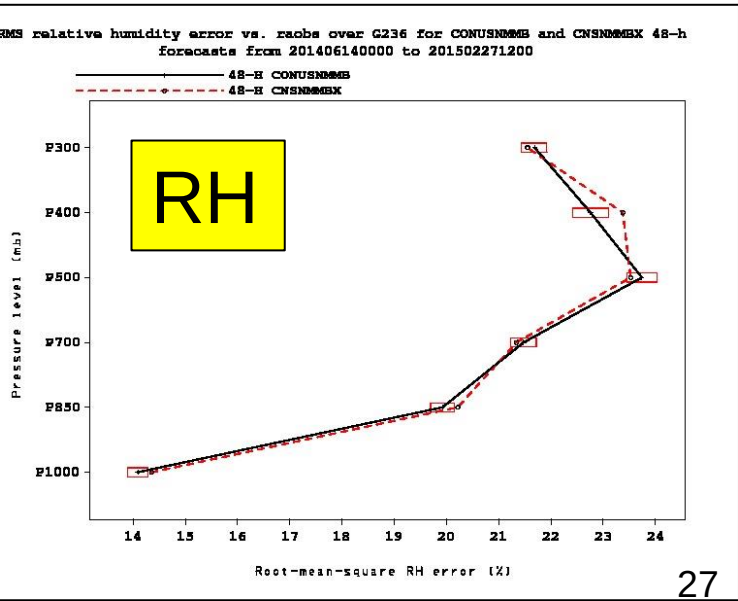


All tests run to date (about 2 months of cases)

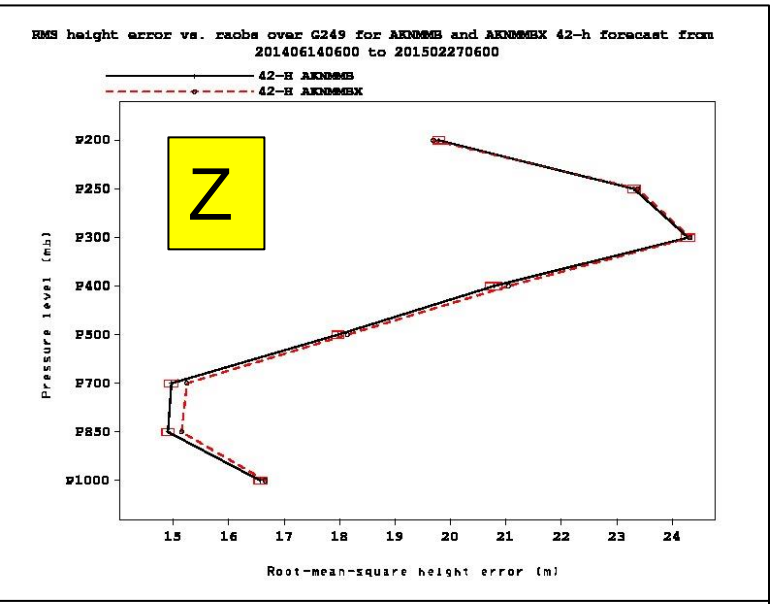
OPS NMMB

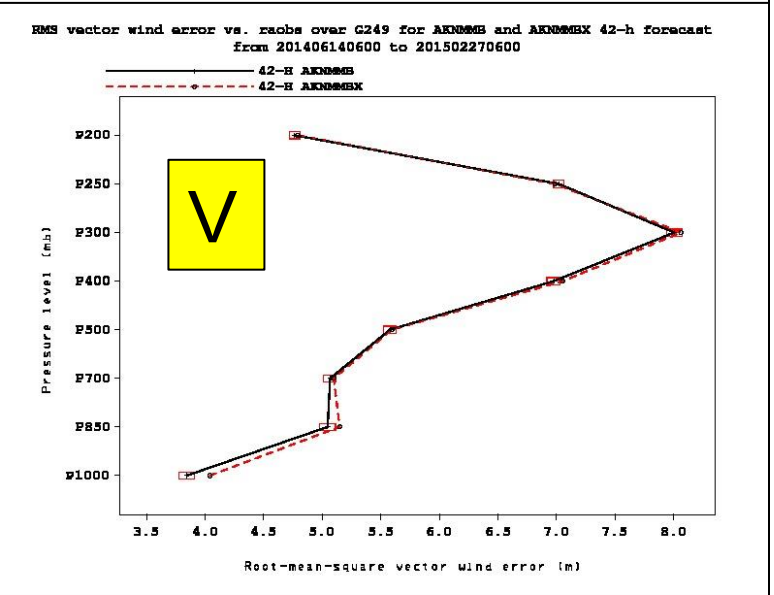
PARA NMMB





RMS errors at 42 h forecast time for AK – NMMB

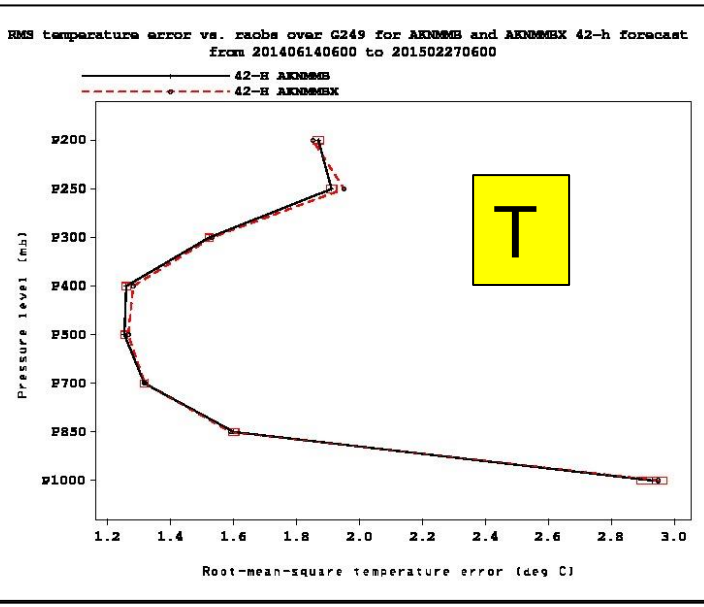


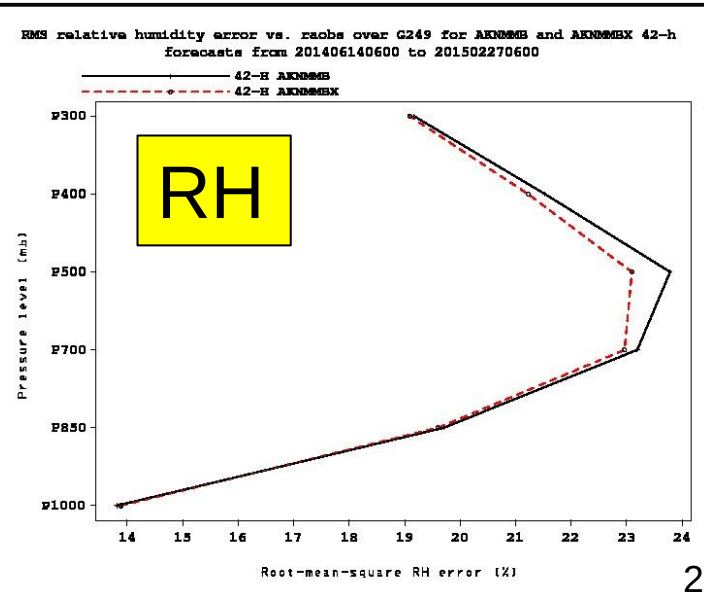


All tests run to date (about 2 months of cases)

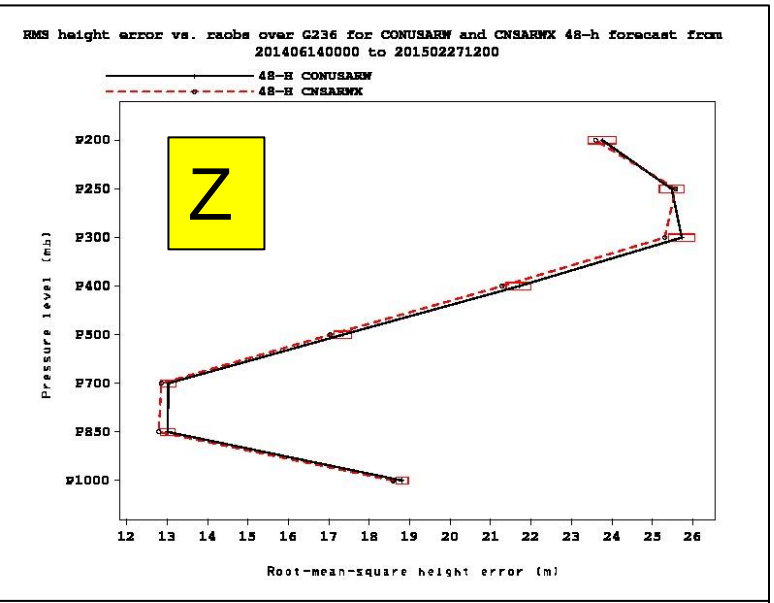
OPS NMMB

PARA NMMB





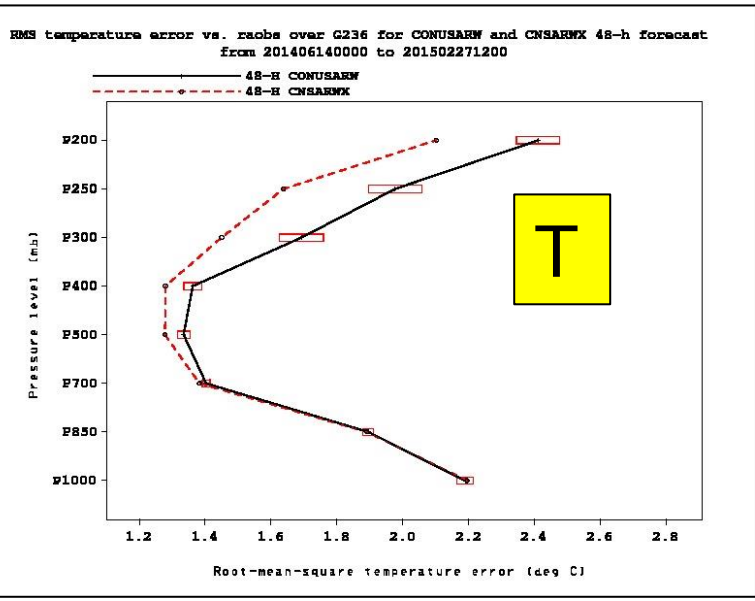
RMS errors at 48 h forecast time for CONUS - ARW

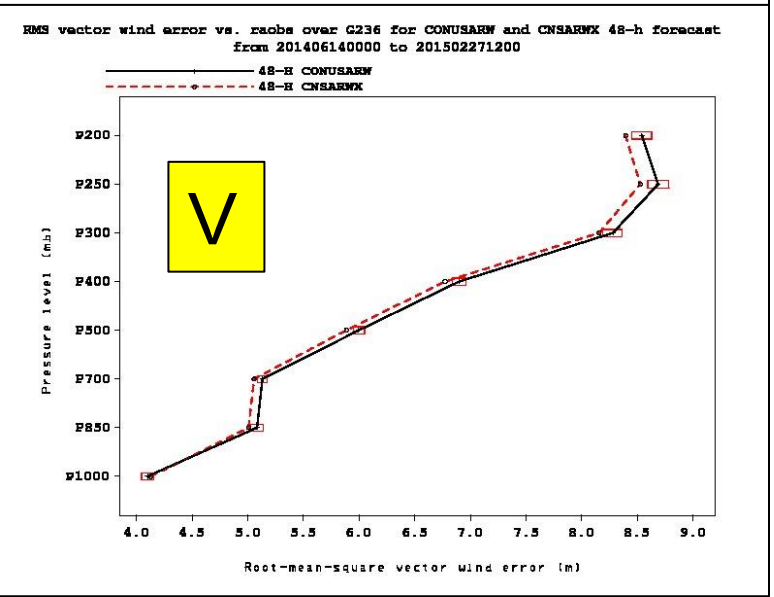


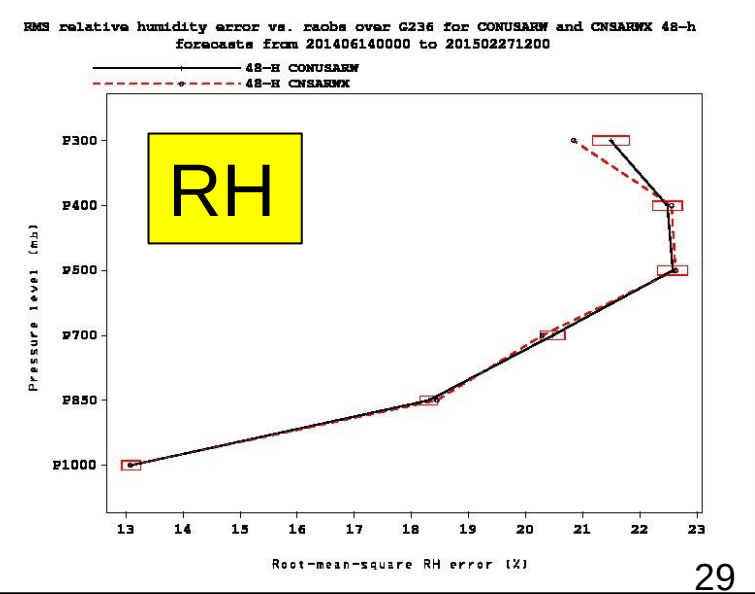
All tests run to date (about 2 months of cases)

OPS ARW

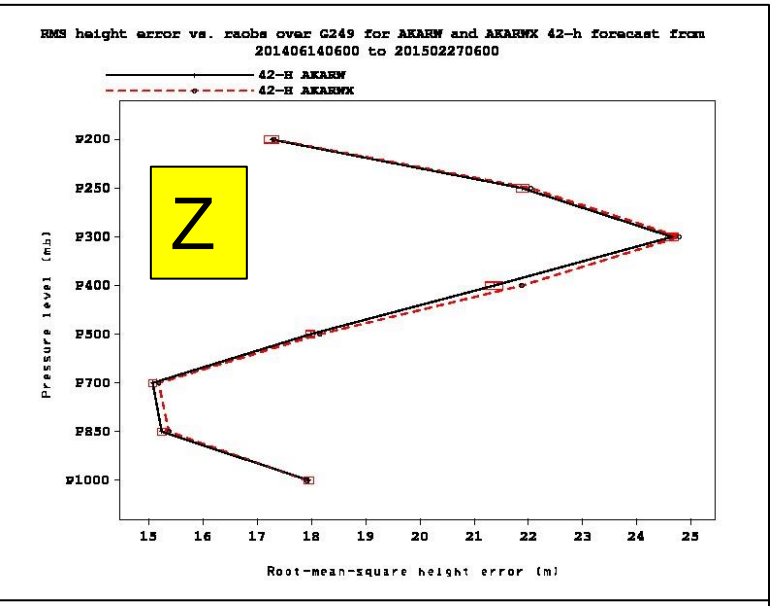
PARA ARW

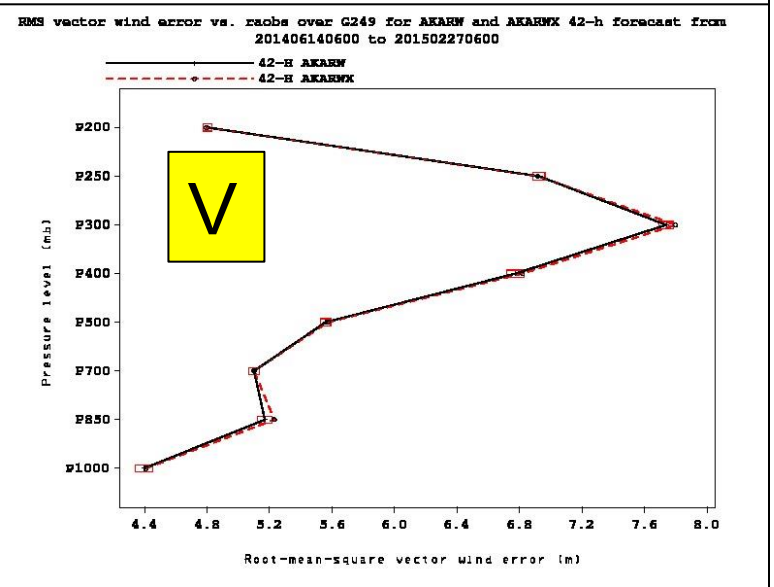






RMS errors at 42 h forecast time for AK - ARW

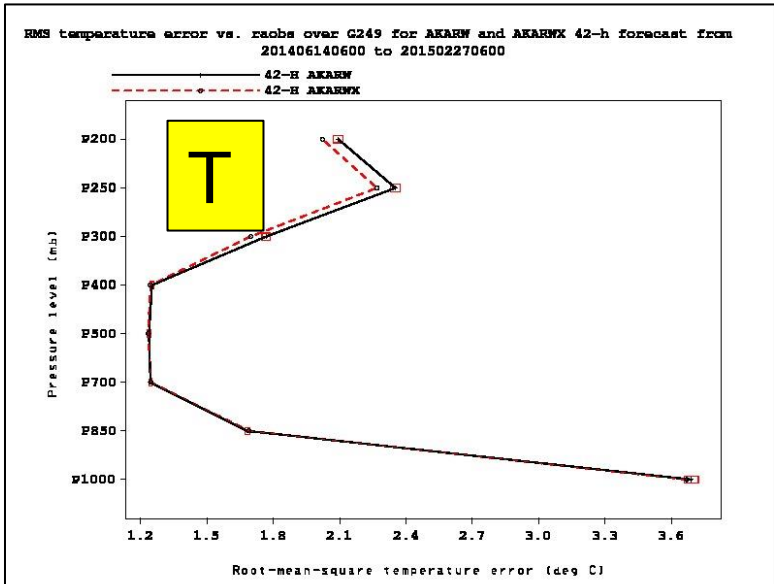


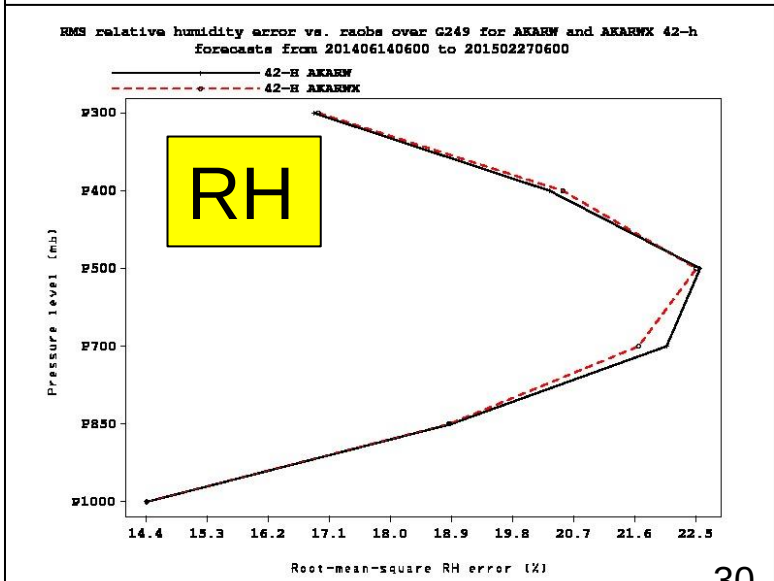


All tests run to date (about 2 months of cases)

OPS ARW

PARA ARW





Summary

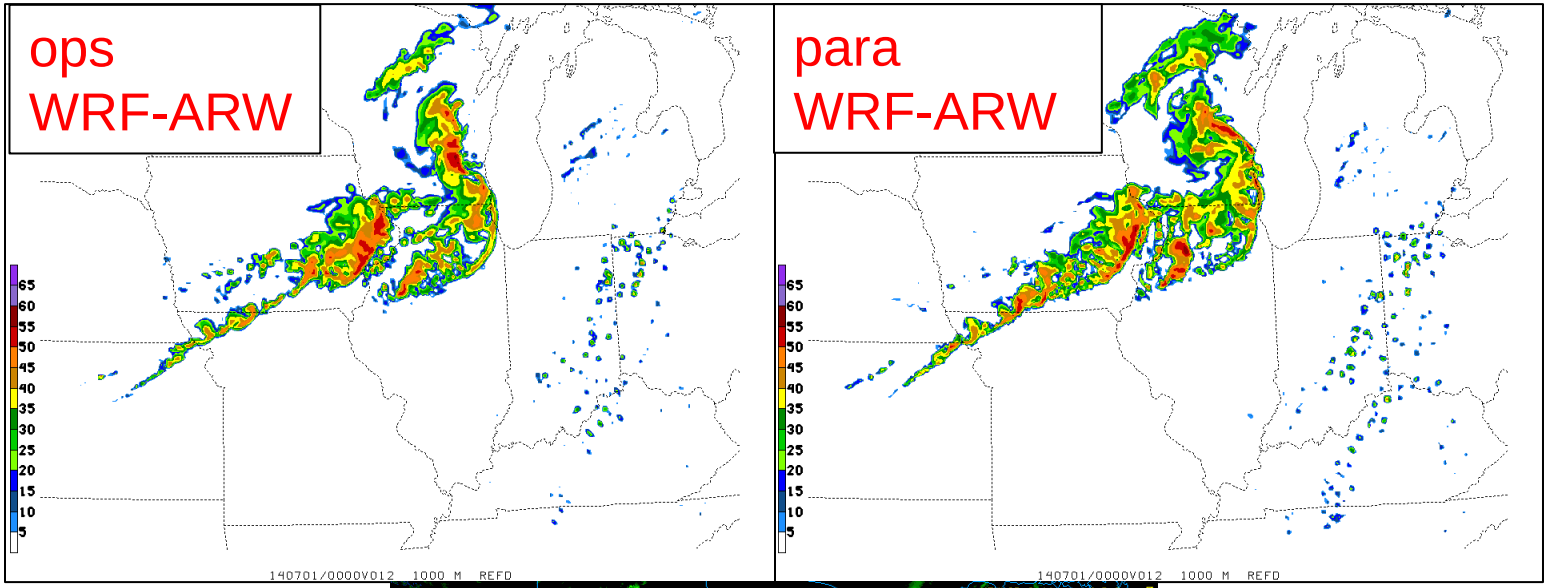
- The parallel HiresW system improves upon the biggest complaints from the 2014 upgrade: echotop height and composite reflectivity in the CONUS WRF-ARW run
- Subtle improvements to precipitation bias and PBL structure
- By most other metrics, change in forecast skill is fairly neutral
- HREF helps pave path to ensemble future, and along with other new products adds forecast utility
- Hoping to hand off code to NCO by next Friday at the latest

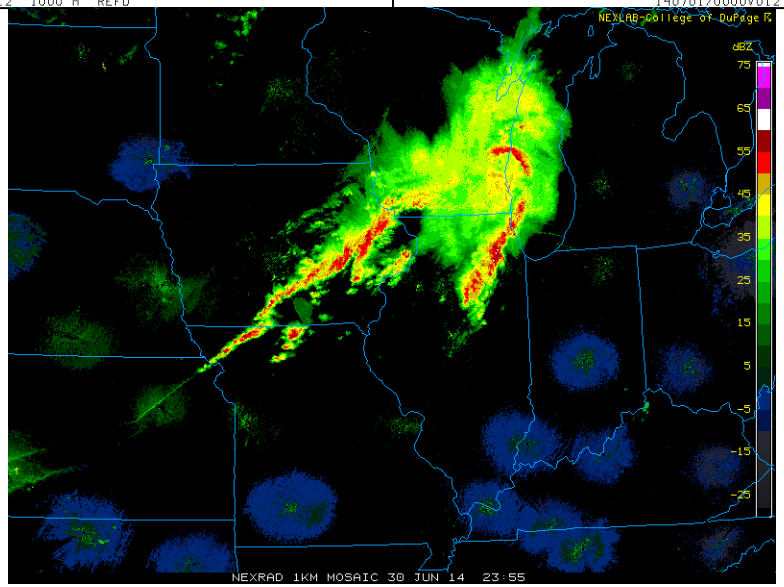
Backup Slides

CPU Usage (model jobs)

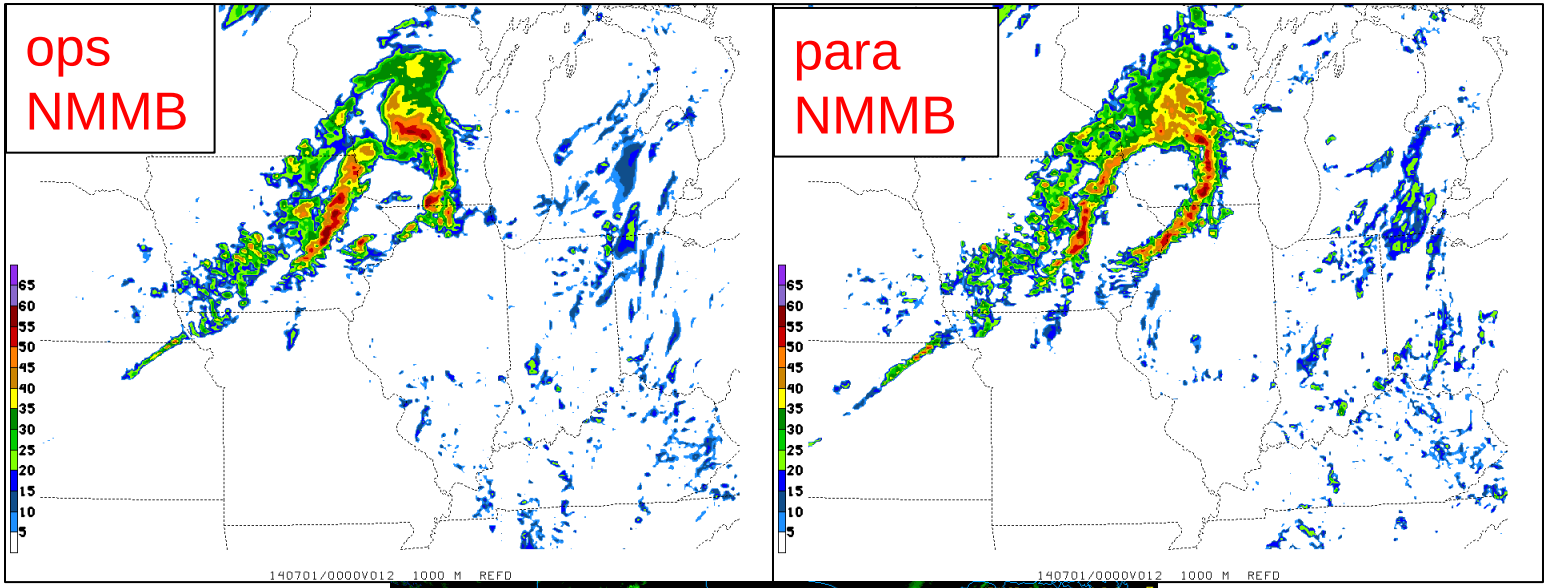
Domain	Ops model tasks (nodes) NMMB / ARW phase1 nodes	Para model tasks (nodes) NMMB / ARW phase2 nodes
CONUS	525(33 nodes) / 592(37)	696(29 nodes) / 816(34)
Alaska	496(31) / 540(34)	672(28) / 720(30)
HI	45(3) / 48(3)	72(3) / 67(3)
PR	80(5) / 80(5)	136(6) / 105(5)
Guam	42(3) / 63(4)	72(3) / 72(3)

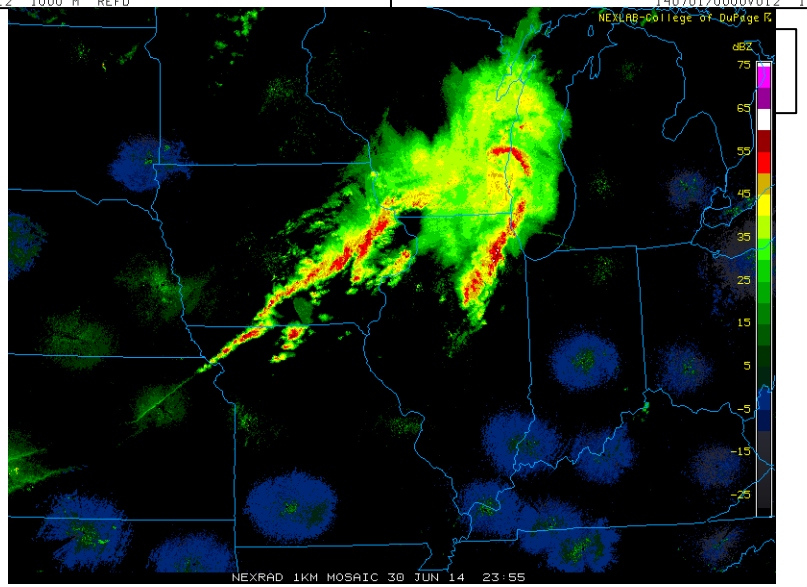
Model and observed 1 km AGL radar, 00Z 1 Jul 2015





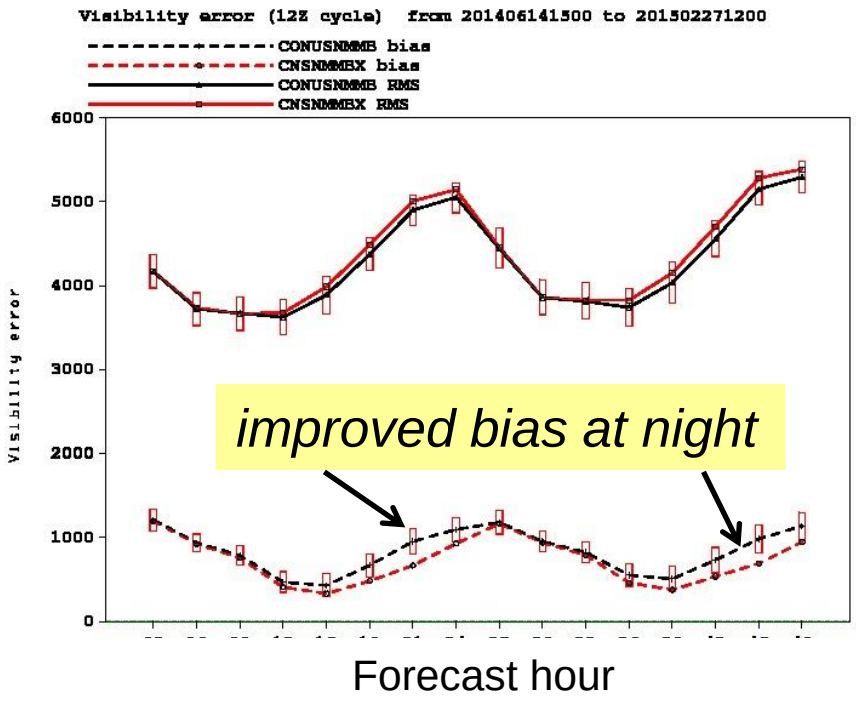
Model and observed 1 km AGL radar, 00Z 1 Jul 2015

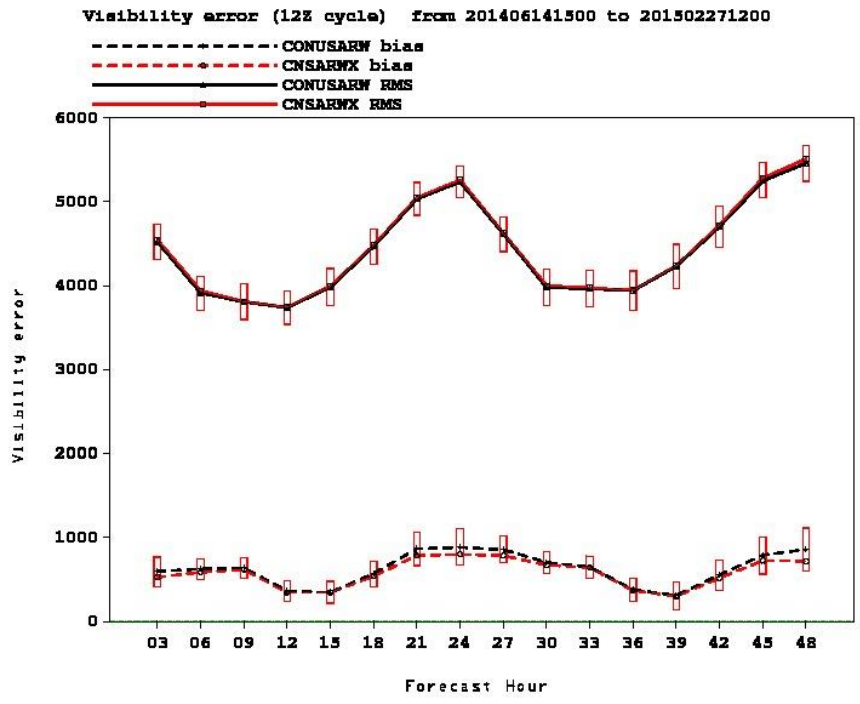




CONUS visibility, 12Z cycle

ops RMS
para RMS
ops bias
para bias



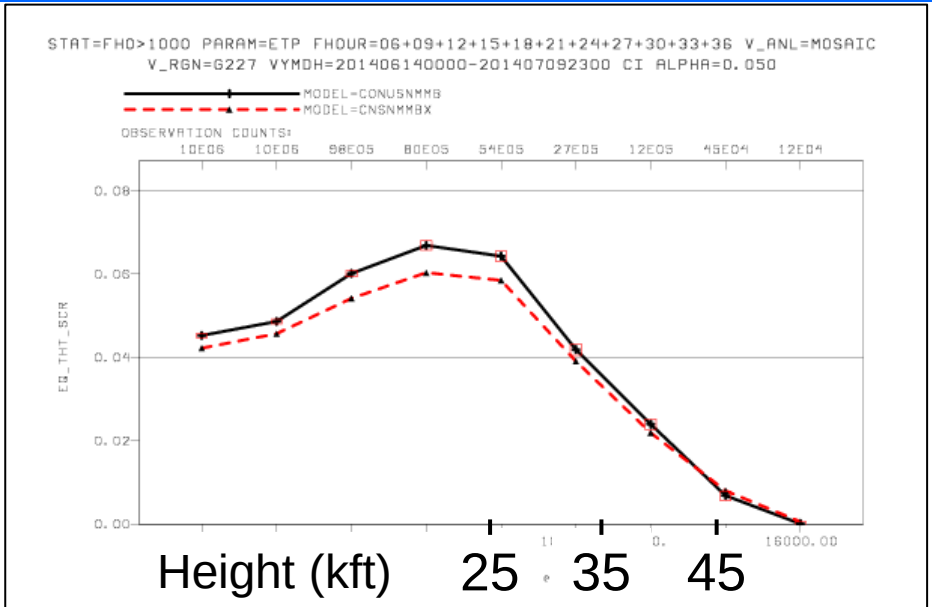


NMMB

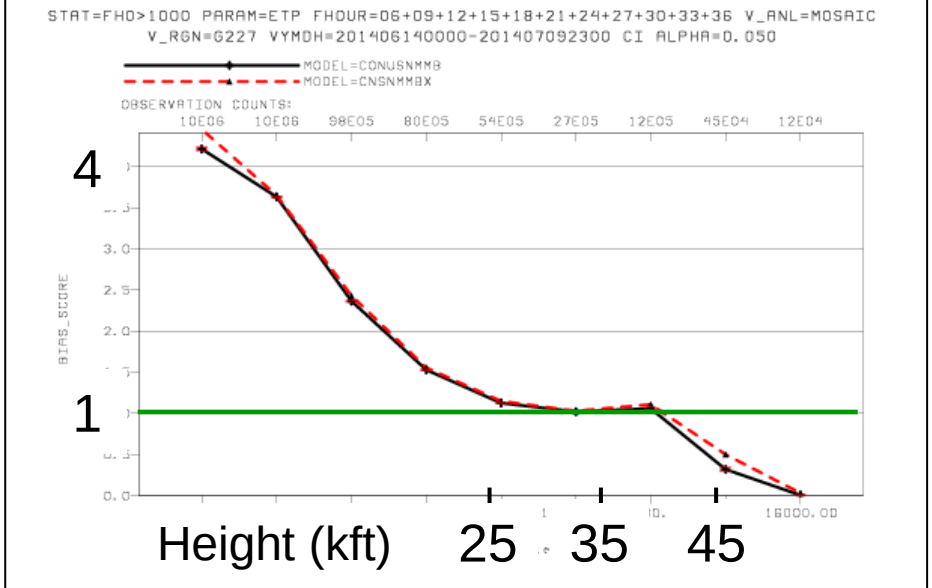
WRF-ARW

Warm season echo top for NMMB (not targeted for improvement like in WRF-ARW)

Equitable threat score



Bias



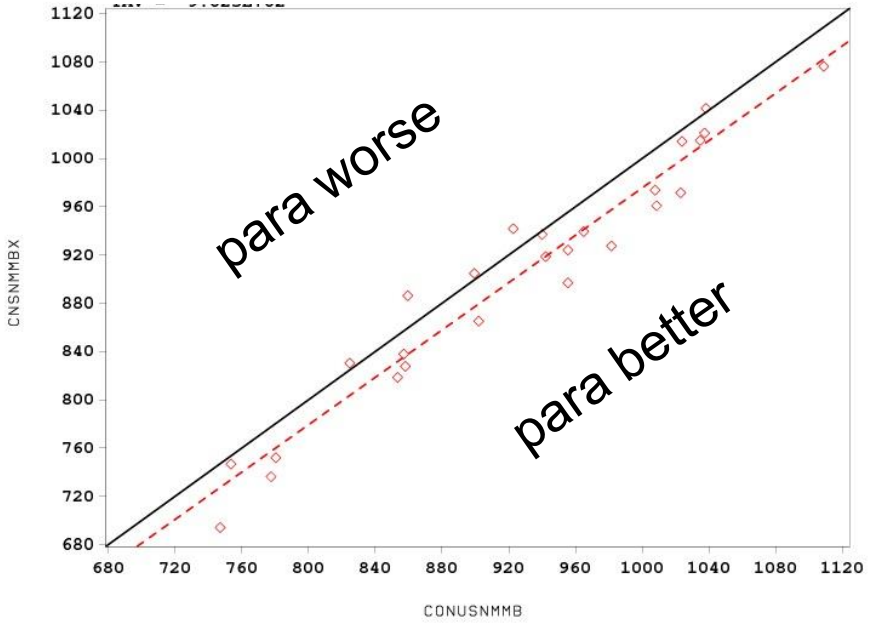
Grid-to-grid verification against radar mosaic

Ops HiresW

Para HiresW

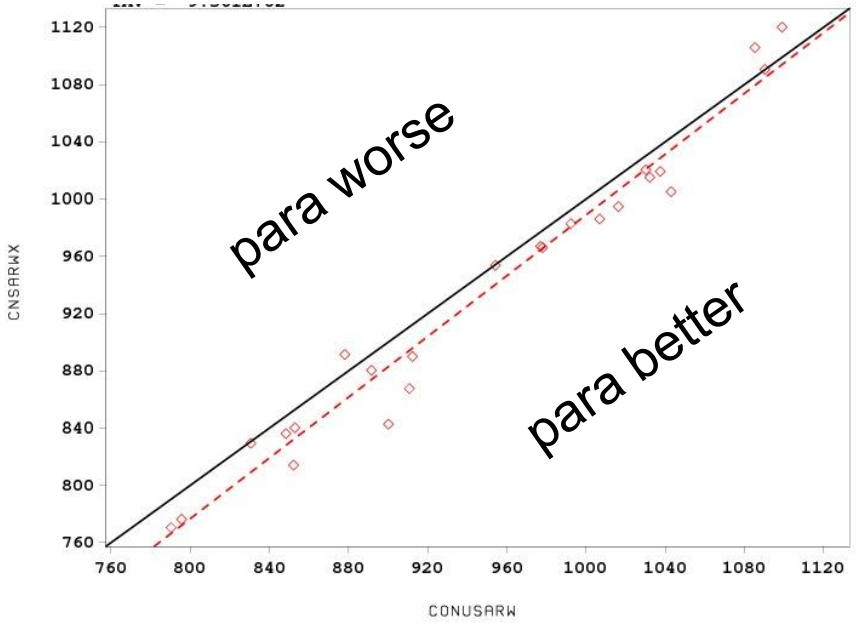
Improved convective PBL height forecasts (warm season, valid 00Z)

CONUS NMMB



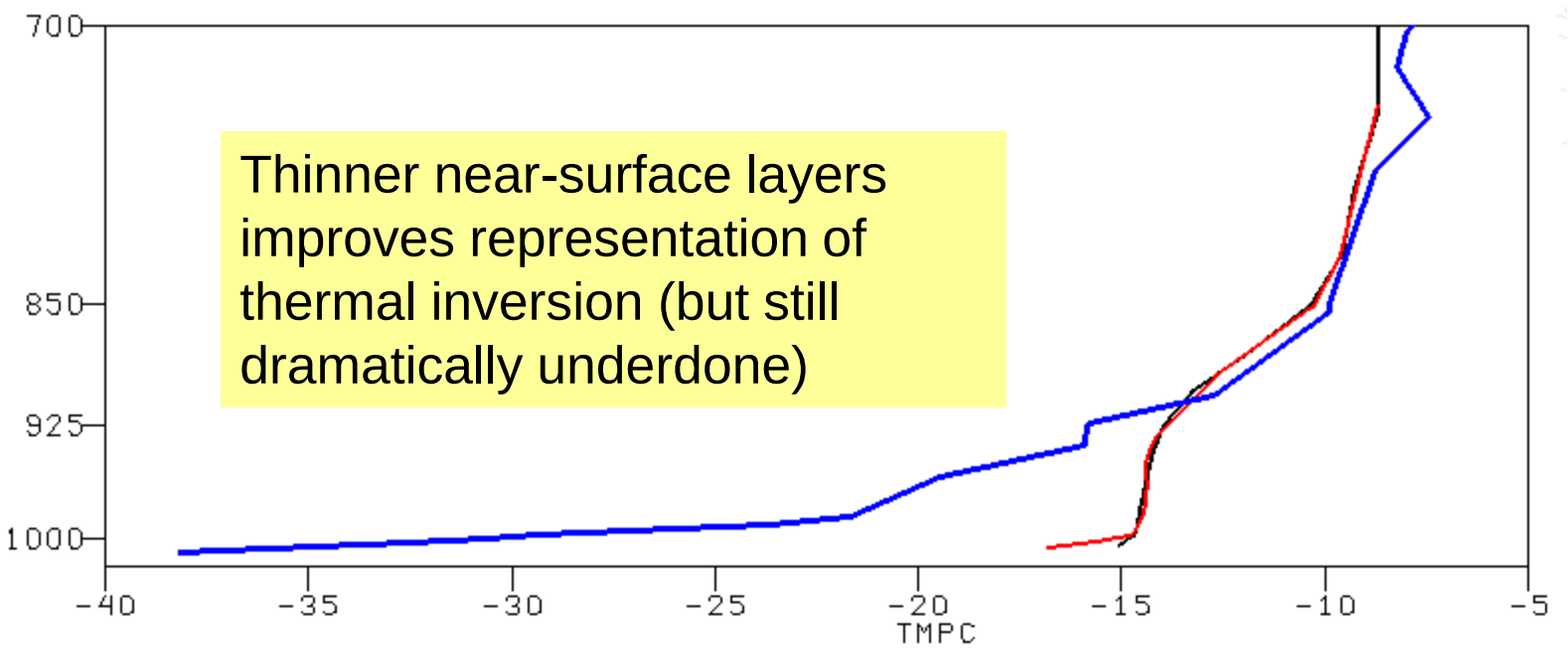
23 m reduction in avg RMS error

CONUS WRF-ARW



14 m reduction in avg RMS error

Representation of shallow arctic air



ARW

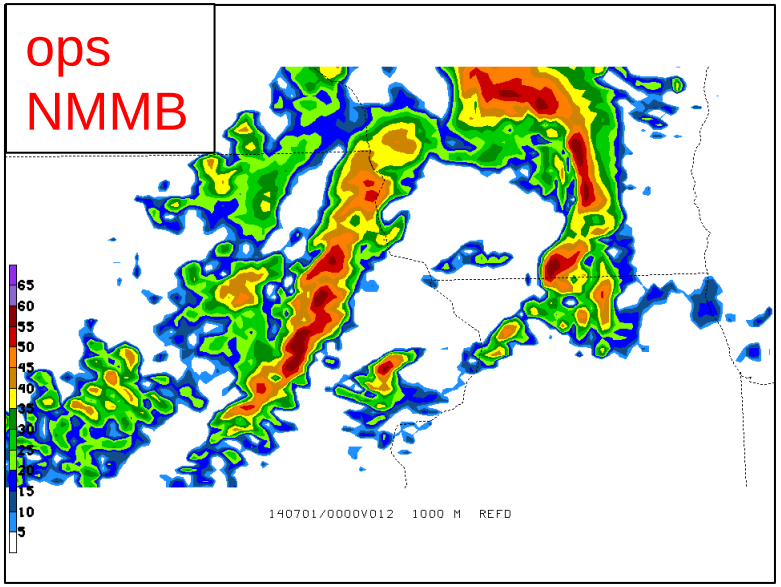
Ops HiresW

Para HiresW

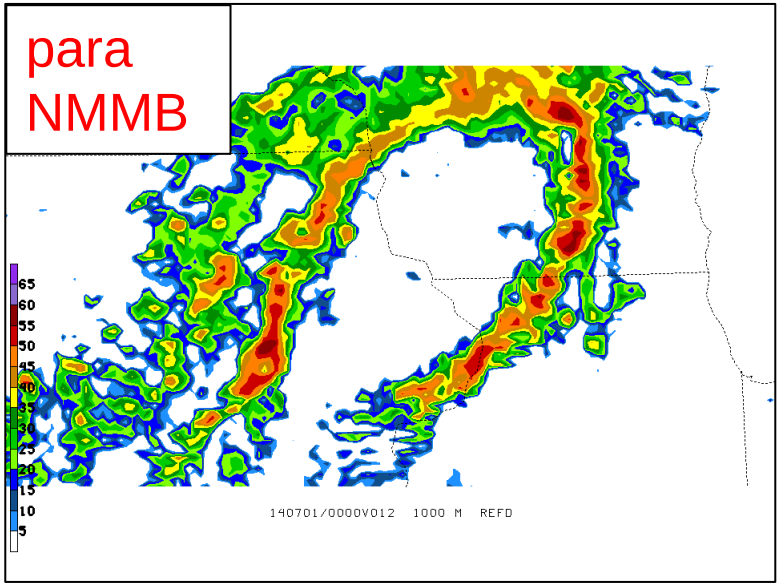
Obs

Model 1 km AGL radar, 00Z 1 Jul 2015

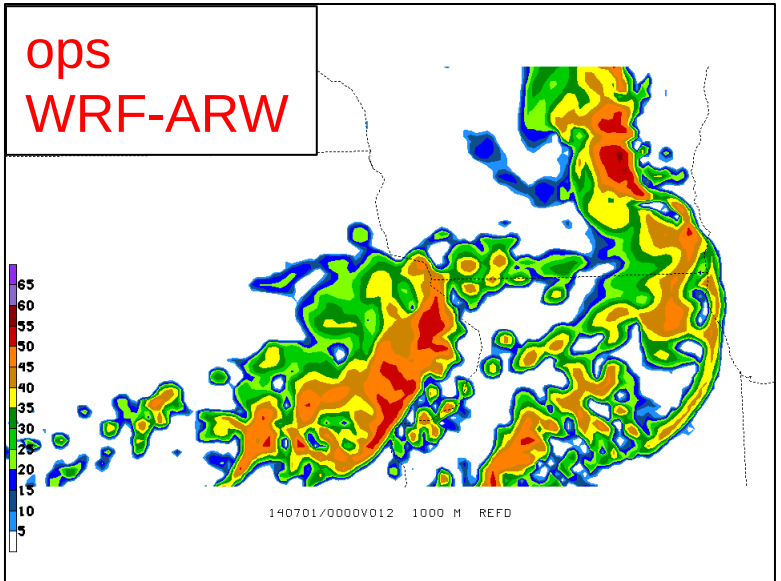
ops NMMB



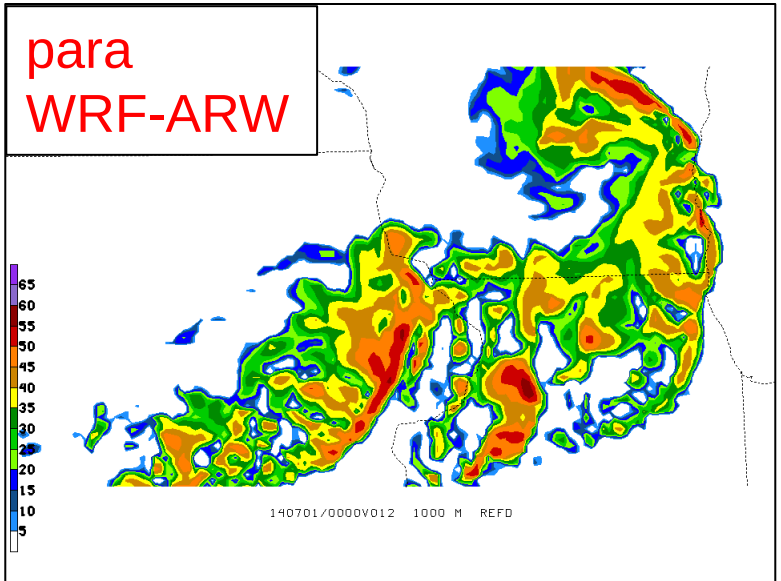
para NMMB



ops WRF-ARW



para WRF-ARW



Model and observed 1 km AGL radar, 03Z 1 Jul 2015